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MANAGEMENT AND USE OF NON-TIMBER FOREST PRODUCTS (NTFPs) AS CLIMATE CHANGE ADAPTATION STRATEGY IN LAWRA DISTRICT, GHANA.

BY

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DECLARATION

I hereby declare that this thesis comprises of data that is based on my own research with steady guidance from my supervisors, and no part of this work except the references which have been accordingly acknowledged belongs to anybody. I also declare that no prior publications of parts or whole of this long essay has been made nor presented elsewhere for any award.

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DEDICATION

I dedicate this work to the late Mr. Adams Soale (former Health Officer, Ghana Cocoa Board) for his great advice and inspiration towards my academic life. May the Almighty Allah be pleased with his soul and grant him abundant mercies. You are missed!

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ABSTRACT

Rural and deprived communities continue to face limited alternatives to supporting their livelihoods that are largely affected by climate change and variability. Non Timber Forest Products (NTFPs) have increasingly been promoted, especially developing countries, as a sustainable livelihood option for forest resources dependent households. The current study sought to identify and assess the use and management practices of NTFPs as a climate change adaptation strategy in the Lawra District, in the Upper West Region of Ghana. The study adopted a case study design with a mixed method approach to data collection. A combination of various data sets including 155 household survey and 5 key-stakeholder interviews with key field observations were used to have firsthand knowledge on the relative spatial distribution of NTFPs. Also, regression, correlations, chi-squares and cross-tabulations were used to established statistical relationships among various variables. Themes were generated using the matrix technique in Microsoft Excel from the in-interviews. The research results show that over the last 30 years in the Lawra district temperature has increased from 25°C in 2007 to 30.1°C in 2014 with rainfall amounts reducing from 107 inches in 2008 to 78.08 inches in 2014. According to the residents, this has led to reduced total output from crops yields. Among the adaptation strategies used by residents, NTFPs collection (39.4%) was the highest. Regression analysis showed that both temperature and rainfall were poor predicators of the availability of NTFPs. About 78 NTFPs (Plant and Animal) were identified in the district with *Adansonia Digitata* (baobab), *Vitellaria Paradoxa (*shea), *Parkia Biglobosa* (dawadawa), *Physalis Peruviana* (yellow berries) and *Gardenia Ternifolia (*kazuge) being the most harvested. NTFPs are generally distributed all over the district and designated into parklands at locations where substantial amount of a species is dominant. NTFPS contributes only 1% of the total household

annual income but remains significant in the varied non-traded roles including food supplement, medicine, employment, nutrition, and energy sources. Finally, the study established that the management of NTFPs included both formal and informal institutions, including participation of individual household members. The nascent NTFP industry in the Lawra district faces among other things, marketing and processing challenges and lack of specific policies on NTFPs management. The study recommends a collaborative effort from the government in ensuring local strategies are sustained and improved, increase education and sensitization programs on climate change whiles providing timely weather related information to farmers with agricultural inputs. Finally, the study calls for a nationwide consultation process to draft a national policy on NTFPs management which will provide strong basis for establishing a resilient value chain industry to support rural livelihoods against the impacts of climate change.

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LIST OF ACRONYMS AND ABBREVIATIONS

NTFP	-	Non-timber Forest Product
UNDP	-	United Nations Development Program
GLSS	-	Ghana Living Standard Survey
GSS	-	Ghana Statistical Service
FAO	-	Food and Agricultural Organization
USFS	-	United States Forest Service
WFP	-	World Food Program
IPCC	-	Inter-Governmental Panel on Climate Change
OECD	-	Organization for Economic Co-operation and Development
CBO	-	Community Based Organization
IFRC	-	International Federation of Red Cross and Red Crescent Societies
CDWR	-	California Department of Water Resources
CDA	-	Canadian International Development Agency
IDRC	-	International Development Research Centre
CIFOR	-	Centre for International Forestry Research
ICUN	-	International Union for Conservation of Nature
BSP	-	Biodiversity Support Program
EPA	-	Environmental Protection Agency
FSD	-	Forest Service Division
MoFA	-	Ministry of Food and Agriculture
DA	-	District Assembly
NGO	-	Non-Governmental Organization

GO	-	Government Organizations
SPSS	-	Statistical Package for Social Sciences

CHAPTER ONE

INTRODUCTION

1.1 Background

Contemporarily, climate change has been widely accepted as a real phenomenon. Even though there are debates on the magnitude of its impact on rural economies amongst scientists, economists and policy makers, there is a general agreement that the world faces existent threats from global warming. Global warming is caused by the rising levels of green-house gases due to natural or anthropogenic forces, which include water vapor, carbon dioxide, ozone, methane, chlorofluorocarbons, nitrous oxide, and other synthetic chemicals (Zaman *et al*., 2015). Unimpeded green-house gases emission increases the earth's temperature, which results in melting of glaciers, more precipitation or drought and other extreme weather events (Fentaye, 2009).

In most parts of Africa, local temperature increase of 2°C and more above the late 20th century levels is projected to negatively impact production and cause general declines in subsistence crops like maize in Ghana; millet and sorghum in Sudan; and groundnuts in Gambia (Edenhofer *et al*., 2014). The impact of climate change on livelihoods in most African countries is increasingly becoming evident, with effects ranging from impoverishment, food insecurity, malnutrition, hunger and unemployment. Climate change may also pose problems for non-farm activities that are natural resource-based, such as hunting, fishing, gathering wild fruits for sale etc.

Achieving food security under the unpredictable nature of the ever-changing climate requires substantial increases in food production and improved access to adequate and nutritious food, of which people in semi-arid areas are no exception (Fentaw, 2011). With increasing concerns on

finding sustainable sources of livelihood for forest dependent communities, non-timber forest products including fruits, flowers, tubers, leafy vegetables, bamboo shoots, honey, mushrooms etc. have been noted to provide food security and other medicinal values in times of droughts (Basu, 2011). For example, in India over 8000 plant species are harvested for medicinal purposes (Basu, 2011), and in Tanzania, NTFPs is a major climate change adaptation strategy for the local people who were traditional rain-fed agriculture dependent, playing a key role in providing income for subsistence as well as providing a safety net for households (Msalilwa, 2013).

According to the UNDP (2004), over 350 million people continue to depend on the benefits from NTFPs including food, nutrition and medicinal values in mostly developing countries. Also noted that globally NTFPs have contributed to the subsistence, employment and cash incomes of the poor in communities especially as an adaptive measure to climate change (Shackleton et al., 2001: Gachathi and Eriksen, 2011: Schaafsma 2011). The works of Nkem (2010) further stresses on efficient utilization of NTFPs as an adaptive measure to climate change variabilities.

The sustainable management of Non-timber forest products (NTFPs) can reduce the vulnerability of people to adverse effects of climate change. NTFPs encompass all goods of biological origin other than timber, which are extracted from forests for human use (De Beer and McDermott, 1989). They may include fruits and nuts, resins derived from plants and animals, game and medicinal plants obtained from tree barks, leaves and roots. NTFPs play important roles worldwide, especially in rural areas where animal and plant resources derived from forests remain central to subsistence and local economies. The relevance of NTFPs goes beyond meeting basic needs. They are also rapidly growing at the international market. A study by the Food and Agriculture Organization (FAO, 2014) suggests that at least 150 NTFPs are of major

significance in international trade, including medicinal plants, mushrooms, snails, essential oils, tannin extracts, gums, nuts, rattans and bamboo. Wildlife (game/bush meat) as a greater part of NTFPs can provide good sources of animal protein as well as income to the surrounding communities (Anamayi *et al*., 2010). NTFPs directly or indirectly contribute to carbon sequestration. The fast growing NTFPs such as bamboo helps in reducing emissions and directly protects the forest system (Zaman *et al*., 2015). Generally, the range of usage of NTFPs have increase more than it used to be some three decades ago, despite the perceived decrease in availability (Msalilwa *et al*., 2013).

NTFPs contribute to livelihoods of about 2 billion of the world's poorest people in urban and rural settlements and are among the most valuable plant resources for present and future food security (Ahenkan and Boon, 2011). In northern Ghana which is a semi-arid region, climate is the most important determinant of the productivity of agriculture and natural resources. The mainstay of most rural economies is agriculture, particularly subsistence farming with heavy reliance on rainfall. As such, agriculture in these areas becomes vulnerable to changes in temperature and rainfall patterns. Drought causes negative socio-economic implications for food production, human welfare and political stability (Sarr, 2012). Nevertheless, non-farm activities are likely to play an increasingly important role in household livelihoods in the future because they offer opportunities for diversification when agriculture becomes riskier (USFS, 2011). Governments and private institutions or individuals have been trying to support the sustainable use of NTFPs but a lot still needs to be done to help develop its production, processing and marketing.

1.2 Problem Statement

Globally, it is estimated that about 800 million people live on less than US$1.25 a day, and about 1 billion people are suffering from hunger. About 70% of these poor people are found in agrarian communities (World Bank, 2012). An estimated 24.2% of Ghanaians are considered poor (GLSS 6, 2013), and 5% of the poor population are also food insecure. At the national level about 34% of the poor population lives in the Upper West region of the country (WFP, 2009). According to the GSS (2014), 80% of the population in the Upper West region is engaged in subsistence agriculture, which significantly contributes to the people's employment opportunities, income, food security, export earnings and source of livelihood at large. However, about 70.7% of the population in the Upper West region records the highest level of (GLSS 6, 2013).

A major problem in the Northern savanna zone is the short duration and or irregularity of the rainy season, hampering the length of growing seasons and crop yield potential, particularly along the semi-arid areas. Late rains and intermittent droughts have become more common causing problems for rainfall-dependent farmers. In addition, existing environmental conditions such as poor soil fertility and increased incidences of pests and diseases hinder the success of agricultural production in the district (GSS, 2014). This affects food security and further exacerbates malnutrition among children in the district. In effect, most households experience food insecure periods spanning between 3 and 7 months (Quaye, 2008). In response, people resort to different coping strategies that are less positive and unsustainable agricultural practices among others that have adverse impacts on the environment. Typical examples are provided by the EPA (2002) who identified bush burning before cultivation and wood harvest as practices that exposes the soil and reduces its fertility.

As posited by Adger et al. (2005), the ability of people to effectively adapt to climate change is largely influenced by their economic conditions. Therefore, to ensure sustainable livelihood, and to enhance resilience of communities in the savanna ecological zone, diversification of household livelihood activities has been identified as a means to sustainable livelihood (Losch et al., 2011). There is the need to consider other alternative adaptive strategies such as engaging in the extraction, processing and marketing of NTFPs which have the potential of ensuring sustainable adaptation and enhancing the resilience of both the ecosystem and the society to climate change/variability. Some common NTFPs in the Savanna zone such as, shea tree (*Vitellaria paradoxa*), dawadawa (*Parka biglobosa*), baobab (*Adansonia digitata*), acacia tree, bushmeat, roots and fodder, are used by several communities for income diversification and also as safety nets in times of resource scarcity and disaster. Traditionally, NTFPs have served to secure the hunger season in rural areas of northern Ghana by ensuring both food and income security during drought periods (Yakubu & Yeboah, 2016). This has also been observed in other parts of Africa, such as the rural areas of Central and South Africa where gathering of wild fruits and other products constitutes an adaptive/coping strategy for unexpected flood and drought (Shackleton et al., 2011), and by households in Tanzania who use firewood, fruits, spices, fodder, traditional medicines and meat, and also harvest trees for the production of timber, charcoal and bricks sold mainly to the capital, Dares Salaam (Shackleton et al., 2011).

There is, however, inadequate information about how NTFPs are managed and used for climate change adaptation in northern Ghana, particularly in the Lawra District, although it is amply evident that a large number of people depend on them for livelihoods: providing food and income during crucial times of need (Solomon, 2016). Literature on NTFPs and livelihood has

largely concentrated on the tropical forests zones in Ghana (Anokye & Adu, 2014; Manso-Howard, 2011, Amisah et al., 2009) with little information on its use and management in the savanna zones of Ghana. This research therefore seeks to fill this literature gap by assessing the use and management of NTFPs as an adaptation strategy to climate change.

1.3 General Objective

The overall research objective is to identify and assess the use and the management practices of NTFPs as a climate change adaptation strategy in the Lawra District of Ghana.

Specific Objectives

The specific objectives are to:

- Investigate local perceptions on climate change
- Identify and document the relative spatial concentrations NTFPs in the study communities
- Estimate the Financial Income Potentials derived from NTFPs
- Assess the contribution of NTFPs as climate change adaptation strategy to te community and household livelihood
- Assess local level NTFPs' management strategies, including challenges and opportunities in the study area

1.4 Research Questions

Specific research questions are:

- How does the local population perceive climate change and variability?

- What types of NTFPs are harvested and used and how are they spatially distributed in the Lawra District?
- What level of income is obtained from NTFPs?
- What is the contribution of NTFPs to household livelihood?
- What is/are the NTFP management strategies, the challenges faced and opportunities available?

1.5 Hypothesis

Ha – There is no significant relationship between temperature/rainfall and the availability of NTFPs.

Ho - There is a significant relationship between temperature/rainfall and the availability of NTFPs.

1.6 Justification of the Study

Literature on the inventory and use of NTFPs in the savannah woodland remain scanty. According to Yabepone (2010), there is the need for an inventory of all NTFPs as a basic source of information upon which the growth, management and use of the NTFP can be based. The recommended method should be through a community participatory approach. He further noted that the problem is exacerbated by the void in national forest policy on NTFPs management that retards the sustainable growth of the industry in the savannah woodland. Local level strategies for the management of NTFPs are not sufficiently documented.

As a stepping stone to addressing the myriads of concern raised by Yabepone (2010), this study aims at providing an inventory on NTFPs, its spatial distribution and use, and local management strategies, including challenges confronting and opportunities for developing the nascent industry. The study will therefore contribute to existing literature on NTFPs in the savannah regions whiles increasing data needed towards the formation of national forest policy targeted at the management and use of NTFPs in Ghana.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section examines the key concepts and themes relating to the thesis in existing literature. Specifically, the review of literature explored the concept of climate change and climate change adaptation strategies, an overview of Non Timber Forest Products (NTFPs), spatial distribution of NTFPs, the types and sources of NTFPs. Furthermore, the review examined the effects of NTFPs on livelihoods, the nexus between Climate change and NTFPs, and the extent to which NTFPs serve as useful materials in adapting or coping with climate change.

2.2 Introduction to the Concept of Climate Change

Climate change is a phenomenon that has gained global attention over the past decades. Although there are varying perspectives on its level of impact across the world, there is nonetheless an agreement on all fronts of academic and social discourse that the phenomenon continues to pose threats to society in many capacities. Climate change has been defined by various scholars, thus there is an array of definitions. However, there have been various points of convergence in terms of key issues that define the concept. The term generally refers to a statistically substantial disparity in both the mean state of the climate or in its variability, continuing for a prolonged period typically decade or lengthier.

Climate change has several causative factors and may be the outcome of natural processes or external forces, or continuous human induced changes in the composition of the atmosphere or in land-use (IPCC TAR, 2001b). Lagos and Wirth (2009) opined that the increasing threat of climate change has become one of humanities greatest challenge, which affects both current and

future generations. Simpson et al., (2008) noted that as a result of climate change, it is likely that extreme weather events such as extensive heat or heavy precipitations will be more frequent and rampant across the world. There are varying causes and effects of climate change across the globe, both temporally and spatially. OECD (2009), climate change scenarios for the West African region for instance include an anticipated increase in mean temperatures and increased evapo-transpiration.

Notwithstanding the vast knowledge of work in terms of research on the issue of climate change, Christensen et al. (2007) notes that on a regional scale, the impact of climate change and the ability to predict the occurrence of such climate change related phenomenon such as drought is really hard due to uncertainties and changes in frequency of occurrence.

2.3 Adaptation to Climate Change

The United Nations Development Programme (2005), noted that adaptation is the process by which the approaches to mitigate the adverse effects of climate change are developed and implemented. IPCC TAR (2001a) also expounded on the terminology as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Swart et al., (2009) notes that climate change adaptation encompass all responses and planned actions taken to mitigate or cope with the impacts of, or reduce vulnerability to, a challenging climate.

Various forms of adaptation can be distinguished, including anticipatory and reactive adaptation strategies, private and public adaptation strategies, and autonomous and planned adaption (IPCC TAR, 2001a). There are many people that are dependent on natural resources for their livelihoods. With the occurrence of climate change phenomena which challenges the source of

these resources, people are adapting by exploring other options to support their livelihoods such as the use of NTFPs.

To reduce the impacts of climate change, a national policy response that is anticipatory, non-reactive, and anchored in a country`s economic development framework and sustainable development is needed (Lagos and Wirth, 2009), The involvement of all stakeholders from local authorities to community based organizations (CBOs) in the design of adaptation strategies is necessary for operative adaptation.

2.4 Overview of Non-Timber Forest Products (NTFPs)

Ingram and Schure (2010) opined that Non-Timber Forest Products (NTFPs) also known as Non-Wood Forest Products (NWFPs) are spontaneous forest products of organic basis, other than timber, obtained from forests, and other wooded land and trees outside forests. Wong (2000) defines NTFP as all materials obtained from natural resources found on forest ecosystems excluding timber, fuel wood, or medicinal plants harvested in parts or in whole.

NTFPs are used for survival needs and also for sale (Clark and Sunderland, 2004), often not subjected to any strict monitoring or coordination by authorities who are mandated to oversee such resource usage, and are thereafter traded on the local market, and sometimes internationally (Ingram and Schure, 2010). The value and quantum of NTFPs and trade circuits are not well known in precise figures. There is very little data on the values and quantities of NTFPs and often times, these data is incongruent both on a regional and national level. The need for nationalistic and international transboundary approaches to NTFPs management was given credence by the beginning of the decade. Whether the extraction of NTFPs is compatible with biodiversity conservation or not is widely debated. Ninan (2006) expounded that while some

suggest that NTFP extraction is financially viable and ecologically sustainable, others point to its adverse social and ecological consequences.

Though there is a quite substantial amount of documentary evidence on the importance and prospects of NTFPs` utilization and its role in poverty alleviation, livelihoods enhancement and ecological sustainability, a lot of misunderstanding is still linked to NTFPs semantics and terminologies (Ahenkan and Boon, 2011). Indeed it has been very difficult to aptly define NTFPs due to the unclear borders between timber and non-timber products, and the inherent difficulty in defining clearly what a forest is. The accumulation of vocabularies relating to a single term with a range of elucidations and none of which is unanimously recognized is at the core of the NTFP semantic confusion. Ahenkan and Boon (2011) further note that the increasing realization of the importance of all forest resources makes the dichotomization of forest resources into timber and non-timber overly simplistic. Notwithstanding the semantic confusion, there is converging view that the advancement of sustainable use of NTFPs could result in a win-win situation for poverty reduction and bio-diversity conservation (Shiva and Verma, 2002; Golam et al., 2008). According to Clendon (2001), this is due to the increasing recognition that NTFPs can contribute significantly to the livelihoods of forest dependent communities.

Indeed the growing significance of NTFP use has brought on board the involvement of various stakeholders across the globe including governments, development partners, NGOs among others over the past two decades who are playing various roles in making sure that society in general use and benefit from NTFP in a sustainable way. Some of these actors Ahenkan and Boon (2011) identified as: the Canadian International Development Agency (CIDA), International Development Research Centre (IDRC), and Center for International Forestry Research (CIFOR),

International Union for the Conservation of Nature (IUCN) and the Biodiversity Support Programme (BSP), among others. The concept of NTFPs has therefore become an economically acceptable ecological option of development.

2.5 Spatial Distribution of NTFPs

Although NTFP production and market studies normally discuss some spatial characteristics like distance, transport infrastructure, forest distribution, and population size, this is rarely formally incorporated into analysis (Perez et al., 2000). Thus most of the results from NTFP analysis tend to be non-spatial. A spatial analysis of the distribution of NTFPs is relevant to policy making regarding specific areas of specialization for communities in relation to the NTFP that is commonly extracted for livelihood benefits. Recent ecological work has considered spatial variables such as distribution of multiple NTFPs (Marshall and Newton, 2003; Straede et al., 2002), differential NTFP distribution across land cover and management types (Dalle et al., 2002; Miller, 2002), and varying NTFP use and management by spatially distinct resource users (Evans and Sengdala, 2002). The integration of spatio-temporal analysis into NTFP studies in addition to ecological studies allows communities, researchers and managers a more complete view of NTFPs and how they fit into complex biophysical, historical and cultural landscapes that are relevant for sustainability and management (Runk et al., 2004).

On a larger spatial level, the tropical world with very dense and varied vegetation types offers more NTFPs. On a more micro scale, forest reserves generally are richer in NTFPs than open bushes and unprotected forests. Grenand (1992) and Phillips et al (1994) noted that different rainforest types offer different arrays of NTFPs. Ndah et al (2013) examined the spatial

distribution of NTFPs in Takamanda National Park in Cameroon and noted that immature NTFPs were more dominant (79.44%) than mature NTFPs (20.55%). This shows that the variation in distribution is not only along geographical lines, but also within the same geographic space, distribution of NTFPs do vary significantly in terms of the nature of NTFP material.

It is also worthy to note that the distribution of NTFPs to a large extent links with the extent of extraction which is constrained by factors such as the nature of the terrain (e.g. steep slopes). Schaafsma (2011) noted that other factors can affect the decision to collect NTFPs including time and costs involved in collection, availability of labor, market access, demand, transportation options among others. Again, it can be deduced that geographic spaces that are experiencing rapid environmental degradation have lesser distribution of NTFPs than areas that least experience such environmental problems.

NTFPs have played very valuable roles in sustaining livelihoods across various parts of the world including Latin America, Africa, and Asia. Rijsoort (2000) noted that variations are however obvious. The growth of huge volumes of the NTFPs in Latin America is characterized by a process of boom and dust, namely the speedy expansion of NTFP extraction followed by overexploitation as a result of growing demand and also a shift in the direction of plantations and substitutes (Rijsoort, 2000).

In Asia for example, colonial rulers have played a minor role in forest resource use and exploitation (Rijsoort, 2000). It is partially for this reason that knowledge of the use and management of NTFPs has been well preserved at all levels of society. However, the increasing population growth and pressure on resources meant that local forests use has grown in a more diversified manner. Rijsoort (2000) identified the variation in the domestication of NTFP as

another factor that affects its spatial distribution. A proper assessment of the detailed historical development of NTFPs in various regions would make it possible to understand the spatial differences in NTFP distribution.

2.6 Types/Classification of NTFPs

According to Shiva and Verma (2002), there is no globally applied standardized system of classifying NTFPs. NTFPs can be placed into categories including end use (medicine, food, drink, etc.), part used (roots, leaves, barks, etc.), or in harmony with main universal classification systems such as the Harmonized Community Description and Coding System developed under the auspices of the Customs Cooperation Council (Shiva and Verma, 2002).

Ahenkan and Boon (2011) identified the following categories of plant NTFPs: food, fodder, medicines, perfumes and cosmetics, dying and tanning, utensils, handicrafts, construction materials, ornamentals, and exudates. They further identified the following categories of animal NTFPs: living animals, honey and beeswax, bush meat, other edible animal products, hides and skins, medicine, colorants, other nonedible animal products (bones used as tools).

Adepoju and Salau (2007) noted that classifying NTFPs into categories is an important first step of understanding the NTFP industry. NTFPs according to Adepoju and Salau (2007) can be broadly classified into edibles and non-edibles.

2.7 General Sources of NTFPs

Unlike timber-based products, NTFPs come from a large variety of plant parts and are formed into a diverse set of products: leaves and twigs that may be component of decorative arrangements, food items such as fruits, fungi and juices, wood carved or woven into pieces of

art or utilitarian objects and roots, leaves and bark processed into herbal remedies or medicines (Adepoju and Salau, 2007). Ibrahim et al (2016) noted that whiles the forest or bush represent the major source of NTFPs for households, an equally significant percentage of households depend on markets to have access to NTFPs. Thus, although the primary source is the forest, challenges from steep landscapes, protection, predatory animals, and transportation, for example, limits household access to NTFPs from this primary source. Many households thus consider the market as their alternative or major source of NTFPs.

2.8 Importance of NTFPs to Household Livelihood

Ingram and Schure (2010) elucidated that Non-Timber Forest Products play an important role in adding up to household income as well as national economy. The assemblage and trade of NTFPs offer an outlet for households to gain income, especially for the rural poor who live in the fringes of forest rich environments. Even though NTFPs offer lower export revenue compared to timber, they provide higher levels of employment. The most common NTFPs that provide significant revenues for harvesters, but also other actors in the value chain, include bush meat, fish, honey, palm wine, mushrooms, rattans, caterpillars, among others. Ninan (2006), opined that NTFPs are important from an economic, social, cultural and ecological viewpoint.

In addition to providing subsistence, income and employment to tribal and indigenous communities, NTFPs are also high value internationally traded products estimated at USD 11 billion a year (SCBD, 2001; Shanley et al., 2002). According to Adepoju and Salau (2007), NTFPs contributes significantly to local and regional economics, and with the current trend in the trade and use of NTFPs, it is bound to grow substantially over the next decades.

Despite the relevance of NTFPs to livelihood security, Adepoju and Salau (2007) opined that it is a diminishing resource as a result of its dependency on land which is known to be under pressure of depletion from agriculture and development of public infrastructure. There is a historic importance of NTFPs to the livelihood of households which can be traced to the period of hunting and gathering. Apart from its economic significance, Cooks et al., (2003) notes that NTFPs may also have cultural significance and value to households. Charlie et al., (2004) looked into the role and importance of NTFPs in daily lives of rural people in South Africa and discovered that more than 85% household used products such as wild spinaches, fuel wood, wooden utensils and edible fruits.

In Nigeria, food security for people dwelling in the countryside is enhanced by growing trees in the home gardens and on farms (Adepoju and Salau, 2007). Leaves, rattan, honey, sap, gums from the small scale industries are important sources of income (Okafor et al, 1994). Many households are able to meet their immediate household needs due to the many varieties and species of NTFPs obtainable by collecting these products from nearby forest, while other households engage in the marketing of these products to earn income. According to Adepoju and Salau (2007), understanding of the magnitude and nature of the role of NTFPs is critical to making right decisions about the management of forests.

2.9 Use of NTFPs

Several comprehensive studies have focused on specific uses of NTFPs such as fruits for food use (Ingram and Schure, 2010), medicinal uses (Vasisht and Kumar, 2004), tree use (Ingram and Schure, 2010), and socio-economic uses (Nlend, 2007). Food use of NTFPs includes using parts

of plants for food particularly fruits, nuts, seeds, and animals. For medicinal purposes, NTFPs have served in several ways including those exported plants or plant parts used locally.

NTFPs have also been used as tools and construction materials. Typically used ones include Rattan (Sunderland, 2001), Bamboo (Tieguhong et al., 2010) and Raphia (Ingram & Schure, 2010). These resources are used as poles in the putting up of buildings and to make various types of construction materials, utensils, and handicrafts. NTFPs have served in many dimensions as source of fuel or energy. Further, the use of flora and faunal resources for cultural purposes including ceremonies and religious events was highlighted by the FAO (1999) overview. The literature on medical plants according Olowokudejo et al., (2008) tends to pay much attention to the usefulness and value of species for traditional and western style medical use, rather than focusing on the prices and quantities, with a few notable exceptions.

2.10 Economic Benefits of NTFPs

Whereas policy-makers have inclined to overestimating the occupational gains linked with timber harvests, the importance of employment and income as key economic indicators in the NTFPs sector was undervalued and continues to remain to a large extent incomprehensible even today. For many managers of forest reserves, NTFPs are still considered as minor forest products. Despite this seemingly unfair appreciation, NTFPs contribute, for example, about 50% of forest revenue and 70% of income through exports in India. Shiva (1993) noted that economically, the collection and sale of NTFPs in India contributes about 10 to 40% of income to the 50 million tribal households. Similarly, about 200-300 million villagers depend on NTFPs to varying degrees.

Tien (1994) noted that there are more than 320,000 people involved in NTFP production in Vietnam. Furthermore, it is noted that about 200,000 people are employed in Indonesia rattan industry alone. These figures are impressive but are underrepresented by the number of forest dependent people and obscure the magnitude of contribution of forest based activities to total income of rural households which case studies have shown to be between 50 to 75%.

In a recent study in India, Pandey et al (2016) estimated that 275 million poor rural people in India depend on NTFPs for at least part of their subsistence and cash livelihoods. In Zimbabwe, 237,000 people worked on Non-Timber Forest Products in 1997, compared to 16,000 in industrial forestry (Anon, 2000) and most NTFPs are sold locally or in regional markets generating direct income to households. In Cameroon, Anon (2000) noted that sales of NTFPs are worth some million euros and outstrip domestic market requirements as market stalls in the cities of Douala and Yaoundé are full of such products as butter tree plums, groundnut tree nuts, Dika bread fruit and kola nut.

The economic benefits of NTFPs are enormous and range from household employment and income to national level revenues. Kar and Jacobson (2012) elucidated that exploring the range and pattern of NTFPs` income support to livelihoods of people in fringe areas of forests and the related socio-economic variables is critical in planning any development and conservation initiative.

2.11 Nexus between Climate Change and NTFPs

The nexus between climate change and NTFPs has gained more attention in literature over the past few decades especially with increasing climate change phenomenon that is putting livelihood stress on households especially in rural areas of the developing world. The impact of climate change on NTFPs is an area that requires greater attention from the research community

(Easterling et al., 2007). According to Irland et al., (2001), the site specific nature of both climate change and the provision of NTFPs services complicate the understanding of climate change on these resources. Upendo (2013) noted that the general influences of climate change on NTFPs resources are more difficult to assess due to high ambiguity regarding ecological effects of climate change and also because of data on the current and projected future demand for these products which is incomplete at global, regional and national levels. Climate change can bring positive outcomes on NTFP collection on one hand, but on the other hand can lead to adverse consequences. For instance, high temperatures would increase the availability of fuel wood which households can harvest to meet their energy needs as well as sell to earn income. Rainy and humid conditions can favor the development and growth of fruits and seeds that can be collected for various uses.

On the flip side however, very high temperatures as a result of climate change can pose the risks of fires, pests and pathogenic disease outbreaks, with negative consequences for food, fiber, and forest production including NTFPs (Upendo, 2013). According to Arnold and Perez (2001), areas with high forest-dependent populations like Africa, expected decline in rainfall figures, and increased drought can exacerbate exploitation pressures on forest and agricultural lands.

The linkage between climate change and NTFPs is not uni-directional, as uncontrolled harvesting of NTFPs can have damaging effects on forests through depletion of vegetation stock and reducing the ability of vegetation and other forest components to absorb carbon from the environment. This reduction in ability of forest ecosystems to absorb excess carbon dioxide from the atmosphere will inadvertently increase the warming of the lower atmosphere and add up to the growing case of climate change. NTFPs directly or indirectly contribute to carbon

sequestration. The fast growing NTFPs such as bamboo contribute to reducing emissions and directly protects the forest system (Zaman et al., 2015), underscoring the role of NTFPs in regulating temperatures. Thus a careful understanding of climate and NTFP use is necessary to generate a win-win situation where people benefit from access of resources without necessarily exacerbating climate change phenomena.

2.12 Use of NTFPs as Climate Change Adaptation Strategy in Rural Areas

As posited by Adger et al., (2005), the ability of people to effectively adapt to climate change is largely influenced by their economic conditions. Therefore, to ensure sustainable livelihood, and to enhance resilience of communities in the savanna ecological zone, the diversification of household livelihood activities has been identified as a means to sustainable livelihood (Losch et al., 2011). There is the need to consider other alternative adaptive strategies such as engaging in the extraction, processing and marketing of NTFPs which have the potential of ensuring sustainable adaptation and enhancing the resilience of both the ecosystem and the society to climate change/variability.

InterAcademy Council (2004) reckoned that the agriculture and forest sectors offer job opportunities to people especially in sub-Saharan Africa. However, agriculture is extremely sensitive to climate change, and this has the possibility of altering food production, particularly in terms of patterns and productivity of crop and livestock systems (Vermeulen et al., 2012). In view of this growing challenge, the collection of NTFPs for various uses has been seen as a security for households to adapt to climate change.

Arnold and Perez (2001) clearly underlined the significance of NTFP collection as a climate change adaptation measure stating that the sustainable management Non-Timber Forest Products

presents a range of potential adaptation options particularly for rural people in developing countries in the wake of climate change effects on livelihoods. The work of Seppala et al., (2009) presents one of few global views on forest and climate change adaptation options with forestry providing diverse resources such as NTFPs which are drawn upon by the respective society for earning livelihoods and adaptation actions. Kalame (2011) highlights the view that the significance of forest resources such as NTFPs as an adaptation measure to climate change effects in rural areas has not received much projection in literature and by governments.

Nonetheless, the significance of NTFPs as an adaptation strategy to climate change cannot be underestimated, as literature evidence points to the fact that NTFPs provide substantial inputs to the livelihoods of forest dependent communities, for example, in India where many have limited non-agricultural income opportunities (Chandrashekaran, 1994).

Additionally, NTFPs are important because they can be harnessed under various atmospheric conditions, be it extremely wet or extremely dry conditions that are unfavorable for agriculture. Thus at a given period of climatic variations, households are able to obtain something that is worth enhancing their livelihoods.

2.13 Threats to Sustainable Use of NTFPS

The extraction of NTFPs is regarded sustainable if its exploitation has no long-term disastrous impact on the regeneration of the extracted resource and when the yield remains more or less unchanged throughout the year (Cunningham, 2000). Compared to timber products, NTFPs have historically been neglected by governments. The capacity to promote sustainable use of NTFP and facilitate increased financial benefits to local users as incentives for forest conservation is consequently low (Adepoju and Salau, 2007).

There seems to be a lack of adequate methodologies and strategies to ensure sustainable use of NTFPs and effectively regulate trade and policy development (Adepoju and Salau, 2007). In other words, policy development is still largely disconnected from field experience. The absence of such policies and sustainable management frameworks has led to the mismanagement of NTFPs across various protected and unprotected forests in a bid to derive livelihoods by indigenous people in such fringe communities of these reserves.

Rosyadi et al (2003) noted that the misappropriation of forest resources due to the absence of decentralized forest management policy is considered a factor for depletion of NTFPs. Persistent logging practices, overgrazing, bushfires, and overexploitation of fuel wood among other human activities pose severe threats to the sustainability of NTFPs use. Although climate change phenomenon such as droughts and floods, and natural disasters pose some level of threats to the sustainability of forest resource access and use particularly in the case of NTFPs, it could be deduced that anthropogenic actions cause depletion at a larger scale and faster rate.

2.14 Enablers of NTFPs

Despite several barriers to the extraction and use of Non-Timber Forest Products (NTFPs), some enabling factors have been identified to promote the resource use as a sustainable livelihood option in forest resource areas. Schreckenberg et al., (2006) identified four key factors that promote the success of NTFP commercialization and use. Among these policies are innovation, collaboration, entrepreneurs, and conducive legislative and policy environment. According to the authors, innovation enables producers and traders to deal with risk and vulnerability, and overcome key constraints to NTFP commercialization.

The existence of collaborative systems in communities, together with the application of local knowledge, enhances the production and marketing of NTFPs. They also noted that although entrepreneurs have been accused of exploiting producers in some cases, they have been influential in enabling NTFP use as a sustainable livelihood option for local people in forest areas. Typically, entrepreneurs help to bridge information gaps (on price, quality and quantity). Furthermore, entrepreneurs with good information on producer and consumer environments help to identify new market niches which local people can explore. Other roles of entrepreneurs include training workshops for local people, and the advancement of capital to ensure consistent product supply. Schreckenberg et al., (2006) also noted that the conducive legislations enables formal and informal NTFP commercialization and resource use especially where permit or certification issues have been less difficult to acquire.

Improvements in transport and communications infrastructure will ease market access and this will be important enabler for NTFP use (Marshall et al., 2006). Evariste and Bernard-Aloys (2016) in a study on sustainable assessment of NTFPs in South-Eastern Cameroon rainforests also pointed to the role of conducive legislative and policy environment in sustaining the use of NTFPs. They clarified that the simplification of NTFP exploitation policy through simplification of access to NTFPs, updating of the list of NTFPs, development of tracking systems for licenses and careful monitoring of quantities used, simplification of transport of different types for NTFPs, and revising taxation regimes is critical to enabling sustainable use of NTFPs.

2.15 Valuation of NTFPs

The production and marketing of NTFPs and services gained prominence in forest management as their demand increased across the globe. However, as a result of absence of important data on

the level of output of NTFPs, its economic significance was seldom accounted for in the valuation of forests (Mahapatra and Tewari, 2005). The valuation of NTFPs therefore now focuses on the whole range of activities and relations linked with production, exchange, transport and distribution of specific products (Jensen, 2009).

Whereas the value of timber products is well known that of NTFPs is hardly publicized and highly debated .There is the need for the objective of valuation exercises to be explicit, that is, to explain how choices are made by individual resource users, or how to maximize community well-being. Ingram and Bongers (2009) explained that many NTFP valuations to date lack quantitative data. This lack of data poses great challenge to the valuation of NTFPs. Explaining the relevance of valuation data on NTFPs, Tewari (2000) clarified that given the global diversity of NTFPs and their uses, data on NTFPs cannot be overlooked. Marshall et al., (2003) uphold similar view noting that the availability of quantitative data on valuation of NTFPs allows for comparisons and generalization of results across ecosystems. A generally accepted methodology for forest product valuation and analysis would eliminate such ambiguities that bedevil the system currently. Ingram and Bongers (2009) explained that when NTFPs move from subsistence use to commercial use, the socioeconomic livelihoods of producers, harvesters, processes, urban traders, and consumers become intertwined through demand and supply inter linkages that can lead to unsustainable exploitation. Thus having knowledge about the real value of NTFPs can be useful to facilitating managerial decisions in the source regions of these NTFPs (Tewari, 2000).

Shaanker et al., (2003) held the view that the ecological consequence of NTFP extraction is very imperative when evaluating in futuristic terms the market value of NTFPs. Thus whiles focusing

on the valuation of NTFPs, there is need for future studies to examine the value of the remaining forest ecosystem, so as to facilitate sustainable management interventions.

A number of limitations have been identified in literature regarding valuation of NTFPs. Ingram and Bongers (2009) noted that varying nuances in meaning results in valuations not being able to satisfy all those who seek to measure the worth of NTFPs. Furthermore, past and current studies have focused on a mono-disciplinary expertise when valuing a market chain, from either economic environmental or social perspectives. Harilal et al., (2006) clarified that a key setback in previous NTFP valuations is a focus on either a specific producer-based geographic setting, or a micro- or project-level, neglecting the broader context related to an NTFP market chain. Economic factors related to the NTFP market chain on a regional or national level are therefore not taken into account in many valuations of NTFPs. Hiremath (2004) explained that there is therefore a need for a holistic approach, taking into account sustainable development aspects when valuing NTFPs.

2.16 Management of NTFPs

There is a prerequisite for baseline ecological data in forest management. Rijsoort (2000) upheld the view that native knowledge and management practices are essential in setting up a sustainable NTFP and broad forest management system. The cultural and religious significance of forests can also play a role in the management of such forest products. It is observed that NTFPs are considered from economic point of view, thus their cultural and spiritual values are often neglected. The lack of these considerations in the use of NTFPs could be debilitating to their sustainable management. Clark and Sunderland (2004) clarified that the management of

NTFPs will gain much success if log extraction takes into account the biological, economic, social importance and needs of NTFPs and their consumers.

Vaughan et al (2013) in a study on forest product management in the United States elucidated that the marginalization of wild crafters (people involved in the harvest of NTFPs) have created a management problem where they are reticent to share information or to participate in government-led initiatives in the management of NTFPs. Vaughan et al (2013) explains that the use of social networking and a synchronous communication via the internet and other means could improve collaboration between the two stakeholders and impact positively on NTFP management.

Padoch and de Jong (1989) noted that managing NTFPs is cost prudent in traditional systems relatively due to its integrated nature with other land-use and labor activities. Yabepone (2010) further elucidated on this view that the literature on traditional management system reveals a wide range of intensity both within and among forest communities, where intensity varies along multiple axes of social, economic, geographic and ecological factors. These include the distance of the NTFP source from dwellings, proximity to market, the commercial value of the NTFP, the nature of ownership and access rights, and the natural productivity of a particular forest area (Bishop and Scoones, 1994). Anderson and Ions (1992) explicated that traditional approaches to management of NTFPs are cost effect because they are carried out in conjunction with other activities. For effective management of NTFPs, their integration with activities such as farming and hunting could be far reaching (Yabepone, 2010).

The operationalization of state co-management policies on NTFPs has often resulted in improvement in the quality of ecosystems and their ecological resources (Yabepone, 2010). Most of the studies however indicate that partaking and benefit sharing with local forest communities

has resulted in more careful management with a subsequent increase in forest cover and increased biodiversity. The socio-economic and environmental effects of co-management initiatives are less predictable with the system neglecting the interests of large portion of forest communities. In Sub-Saharan Africa, in terms of the distribution of social and economic benefits of NTFP management, those initiatives that incorporate pre-existing institutions and organizations appear to have the most progressive results (Agyemang, 1994). Notwithstanding this, because of historical neglect, Siebert (1995) explicated that NTFPs in conventional scientific forest management has several information gaps.

2.17 State-led Management Approaches

Until lately, many forestry agencies both governmental and non-governmental in the tropical regions were not actively managing for NTFP production, thus research has been limited in this area of study (Neumann and Hirsch, 2000). According to Tewari (1994) it is only after the International Timber Organization called for the study of NTFPs in 1988 that research interest gained impetus and management studies began to emerge. Neumann and Hirsch (2000) noted that there are currently very few areas that are managed by the state with an explicit NTFP emphasis. Particular commercially valuable NTFP species have been singled out as having potential for management on large scale state-owned reserves.

Despite initiatives, NTFP utilization in national forests across the tropical world has by and large been ignored in forest management practices. Harvesting has often been allowed, sometimes through a permit system. In addition, commonly in state reserves, NTFP harvesting has been viewed as being in conflict with the goals of forest management, whether orienting towards protection or timber production. Agyemang (1994) noted that when the state allows access through permit systems, it can be an opportunity for corruption and bribery and the source of

conflict between the government forest officers and local communities. Siebert (1995) points that access to NTFPs has been prohibited in many forms of state reserves, yet it often continues illegally and unmanaged and the national parks of Sulawesi, Indonesia are classic examples.

Gunatilake (1994) cited in Neumann and Hirsch (2000) suggests that a long term management plan of a protected forest should include programmes to reduce peripheral villager forest dependency, an approach that is to integrate local communities into the overall management of the forest by diverting demand. Instruments for achieving such state-led management approach include the creation of buffer zones, community-based management projects and community plantations (Neumann and Hirsch, 2000).

2.18 Participatory and Co-management Approaches

The use of participatory approaches in forest management generally has gained momentum globally over the past two decades and it includes the interests and needs of all forest users, not just timber extractors. According to Neumann and Hirsch (2000), the approach calls for the participation of rural forest-dwelling agricultural communities in some form in the management of resources from state-owned or communal forests. Participatory management approach was introduced in response to the social and political pressures applied by disenfranchised customary forest users to state agencies.

It is appropriate to expound that participation can range from giving some level of usufruct rights to local communities to the creation of state-owned forests by special agencies (Neumann and Hirsch, 2000). Almost by definition, participatory forest management integrates some level of NTFP extraction by local people in fringe communities of such forest rich areas.

2.19 Implications of NTFP Use and the Need for NTFP Farming

Harvesting NTFPs do have major implications on the species concerned or on the forest ecosystem. Rijsoort (2000) notes that an understanding of ecological strategies of plants and animals is essential and that such an understanding of ecological strategies needs to form the basis for the construction of forest and NTFP management systems. Rijsoort (2000) further expounds that there is need for the development of short, simple, participatory methods based on native knowledge which is able to induce the knowledge necessary for taking management decisions. Looking at the socio-cultural aspects, Rijsoort (2000) noted that indigenous knowledge and management techniques are critical in putting up a sustainable forest management system. The cultural and religious significance of forests also play a role in forest management. Thus managerial actions needs to examine broad ecological, social, cultural and spiritual issues as they are directly and indirectly linked to NTFP use and have implication on sustainability of the resource.

Ahenkan and Boon (2011) noted that indigenous people are losing their access to valued flora and fauna species either through overexploitation and habitat destruction or through loss of access as past harvesting areas are included within protected areas. Marshall et al (2005) explained that in accomplishing sustenance of NTFPs, harvest and forest conservation depend on the ability to reconcile ecosystem productivity with human exploitation. As a result of the recognition that the exploitation of NTFPs from natural forests has limited potential for improving household economies, there has been a paradigm shift in scholarly works that began to question whether the objective of enhancing livelihoods through forest based strategies like NTFPs harvesting could not be better fulfilled by optimizing NTFPs production through

domestication (De Jong et al, 2002). Rajesh (2006) notes that intensified management and domestication of NTFPs may be an important means of improving livelihood of poor through higher yields.

2.20 Conceptual Framework

According to Scoones (1998), sustainable rural livelihood has become a central debate theme in the literature of rural development. The Sustainable Livelihood Framework (SLF) originally developed by DFID has been built on after discussions at the Institute of Development (IDS) in 1997. The major strength of the outcome framework is its ability to lend itself to various livelihood and assets contexts. The SLF responds to a number of key questions which includes what the relevant outcome indicators of sustainable livelihoods are? What are the available livelihood resources, institutional processes and livelihood strategies which are important in enabling or constraining the achievements of sustainable livelihood for different groups of people? And what are the practical operational and policy implication of adopting a sustainable livelihood approach?

The framework further holds that that the key element should fundamentally respond to the following:

"Given a particular ***context*** (of policy setting, politics, history, agro-ecology and socio-economic conditions), what combination of ***livelihood resources*** (different types of 'capital') result in the ability to follow what combination of ***livelihood strategies*** (agricultural intensification/extensification, livelihood diversification and migration) with what ***outcomes***?" (Ibid)

The framework also identifies the key role of institutions both formal and informal institutions that act as agents to mediate how the strategies will be carried out to achieve (or not) the intended outcomes. The framework can be applied at different levels of scale including the individual, household, household clusters among others. The framework has been adapted for this study, which seeks to examine the role of farming and NTFPs in sustaining the rural livelihood of people in the Lawra district (Figure 2.1). The framework holds that in a given context of climate change, both temperature and rainfall become determinants of agriculture (farming) output, which is the major livelihood of the people in the Lawra district. With evidence of climate change in the district, the output of their traditional livelihood (farming) will be affected and will lead to households finding adaptive and alternative measures to sustain their livelihood. This could be done though instituting adaptive measures to improve agricultural yields or through the collection of NTFPs to complement the low yields from agriculture.

Adopting the use of NTFPs as an adaptive strategy will be useful as these not heavily reliant on climate changes. However, in order to ensure maximum benefits from the collection of NTFPs, that will be dependent on the management strategies adopted by various institutions including formal and informal institutions. A positive outcome of the management strategies instituted is likely to lead to an addition to the various livelihood capitals including natural, physical, social, financial and human. Access to these will increase the resilience of households and individuals to climate change effects on their traditional source of income. In situations where the strategies adopted are ineffective through unsustainable environmental practices, this will increase the vulnerability of households as they are deprived of the various capitals needed to sustain their livelihood. This further increases their vulnerability; reduce their resilience to climate change variability.

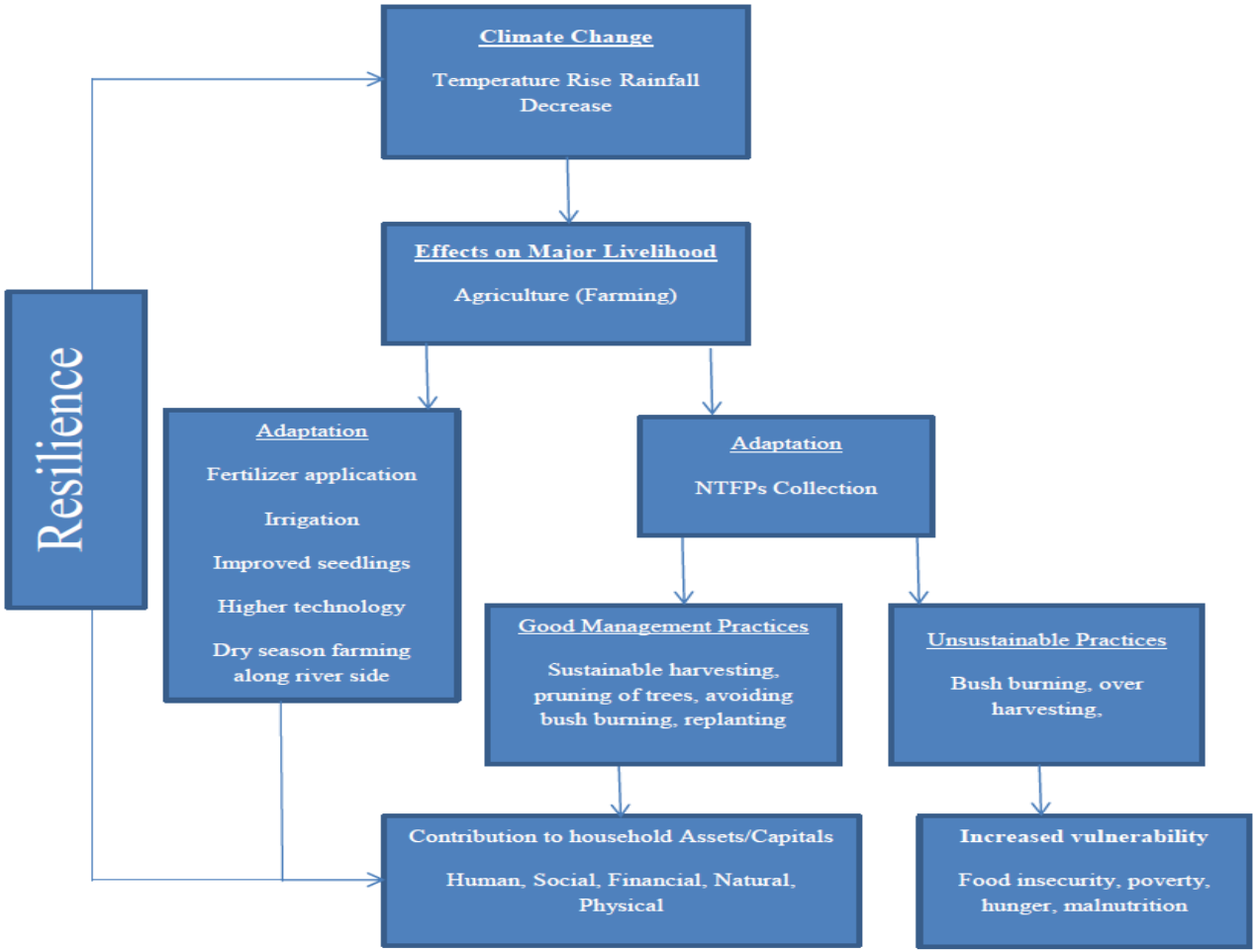


Figure 2.1 Conceptual Framework of the Study

Source: Adapted from Scoones (1998) Sustainable Livelihood Framework

CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.1 Study Area

3.1.1 Location

The study area was carried out in the Lawra District, located found in the Upper West Region in Northern Ghana. It is one of the eleven districts that make up the Upper West Region. It lies in the north-western corner of the Upper West Region in Ghana. It is bounded to the north by Nandom District, to the east by Lambussie-Karni District, to the south-west and west by the Republic of Burkina Faso. It lies between Latitude 10° 30′ 0″ N and longitude 2° 35′ 0″ W. The Lawra District has over 80 % of the inhabitants living in the rural areas. The population density of the district is 104.1 per square kilometer (GSS, 2014).

3.1.2 Vegetation and Climate

The district lies within the Guinea Savannah Zone which is characterized by short grasses interspersed with woody plants. Common trees in the district are drought and fire resistant trees such as Baobab (*Adansonia digitata*), Dawadawa (*Parkia biglobosa*), Shea (*Vitellaria paradoxa*) and Acacia. The vegetation is very congenial for livestock production, which contributes significantly to household incomes in the district. The greatest influence on the vegetation is the prolonged dry season. During this period, the grass becomes dry and gets burnt which leaves the area patchy and mostly bare vegetation. Consequently, the torrential early rains cause excessive soil erosion. Bush burning reduces the vegetative cover and transpiration; and this affects average annual total rainfall resulting in low agricultural yields as farmers depend mostly on

rain-fed agriculture (GSS, 2014). The climate of the district is the tropical continental type with the mean annual temperature ranging between 27° C and 36° C. The period between February and April is the hottest. Climatic changes of late, however affects the weather pattern. Between April and October, the Tropical Maritime air mass blows over the area which gives the only wet season in the year (GSS, 2014).

3.1.3 Geology and Soils

The rock formation in the District is essentially Birimian with dotted outcrops of granite. The District mineral potential is largely unexplored. There are indications of the presence of minor deposits of manganese, traces of gold and diamond, iron ore and clay. As a result of a well-developed fracture pattern in the rocks, the potential for obtaining ground water in the district is very high which makes it suitable for all year-round farming (GSS, 2014). The soils in the district consist mostly of laterite soils. These are developed from the Birimian and granite rocks which underlie the area. The general nature of the soils, coupled with the traditional land use practices and the rainfall pattern, tend to have adverse effect on crop production resulting in persistent shortfall in food production (GSS, 2014).

3.1.4 Relief and Drainage

The district is gently rolling with a few hills ranging between 180 and 300 meters above sea level. It is drained by the White Volta River, to the west forming a boundary between the district and the Republic of Burkina Faso. The White Volta River has several tributaries in the district; notably amongst them are the Kamba/Dangbang, Nawer and Duodaa (GSS, 2014)

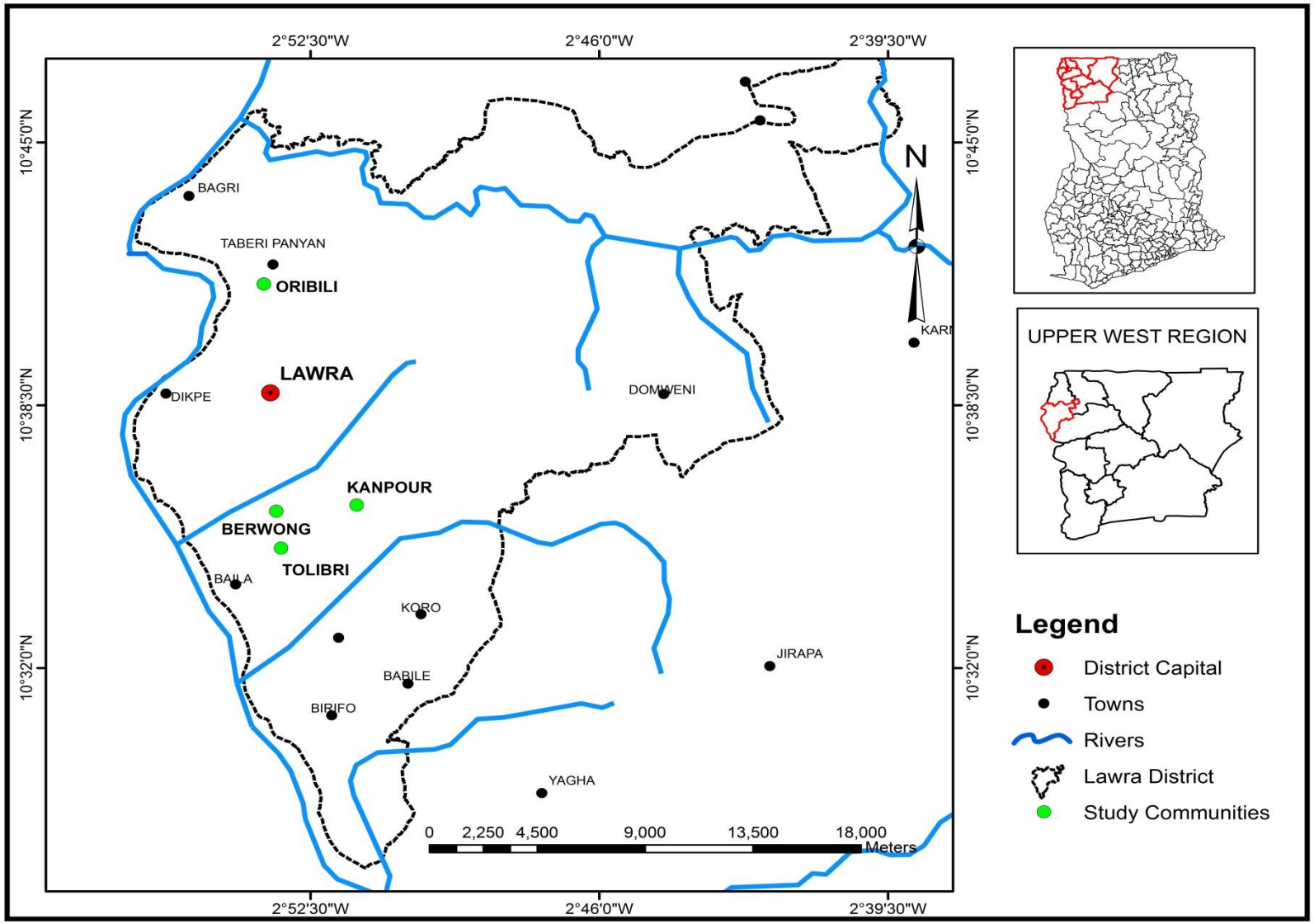


Figure 3.1: Study Area Map of Lawra District

3.2 Methodology

This section explains the procedures that were employed in carrying out the study, including the research design, sampling method and data sources. Also described are data collection techniques as well as techniques for data analysis.

3.2.1 Research Design

The study adopted the mixed method approach to gather relevant data on NTFPs and climate change for analysis. According to Creswell (2014) mixed methods involves the collection and mixing both quantitative and qualitative data in a study. Further, he noted that the advantage in integrating the two forms of data in a single study is based on the assumption that combining both approaches provides a rather complete understanding of the problem investigated than either approach will present. The quantitative data provide insights into changing climatic conditions and the implications on NTFPs availability, collection and management. The qualitative data on the other hand had provided respondents the opportunity to share their experiences with climate effect on NTFPs collection and management at the community level. The triangulation of both data in the analysis has ensured complementarity as well as overcoming the inherent weaknesses in either methods (Tashakkori and Teddlie 2003).

3.2.2 Data Sources

The study used gathered data from both primary and secondary source. The primary data were gathered both quantitatively and qualitatively. This helped to have enough data to support the mixed method research approach adopted by the study. The primary data included the gathering

of both qualitative and quantitative data from all study communities on climate change and NTFPs collection and management..

The secondary data included data gathered from various other sources including documentary reports received from the Lawra district assembly, NGO groups as well as reports on climate change and agriculture from the Lawra Traditional council among others. These reports together with those gathered from the wider literature provided resource rich information for analysis of the problem under study. Other secondary data received included forest resource management plan from the District forestry service division, environmental protection policies from the Environmental Protection Agency and Demographic data from Ghana Statistical Services.

Finally, to establish historical trend and climate variability of the area, climatological data will be obtained from the Ghana Meteorological Agency at the Wa Regional Coordinating Council (RCC). This will help validate the occurrence of climate variability and change in the district. The climatological data obtained will be displayed in a chart showing the trend in annual rainfall and temperature for a minimum period of 30 years.

3.2.3 Data Collection Instruments

The study adopted varying data collection instruments to cover all the approaches used. In gathering quantitative data, the study used questionnaires to gather information from residents of all four communities selected for the study. The household questionnaire was structured with both close ended and open ended questions. The household questionnaire however focused on the bio-data, observations, and practices of interviewees on climate change conditions as well as NTFPs collection and management in the study area.

On the other hand, the study conducted key in-depth interviews with key stakeholders in the management of NTFPs and other forest resources. This gave opportunity to interviewees to express their lived experiences and daily observations on the climatic conditions as well as climate change effects on NTFPs. Additionally, qualitative data was also gathered through focus group discussions organized in the various communities of study.

3.2.4 Sample Size Determination

According to GSS (2014), a total number of 9,200 households were recorded in the Lawra district. If at least one member of a household engages in either the collection/gathering, processing and marketing of NTFPs, such a household is qualified as NTFPs management household. The total household value of 9,200 will be used to represent the sample frame for the questionnaire administration. The sample size will then be obtained using the formula for determining sample size from a definite population (Puopiel, 2010).

Formulae: $n = \frac{N}{1+N(\alpha^2)}$;

Where n= Sample size

N= Sample frame (9,200)

α= Margin of error (0.08/92 % confidence interval)

$$n = \frac{9,200}{1+9,200(0.08^2)}$$

$$n = 154.92 \sim 155$$

Therefore, the sample size for the survey will be 155.

However, for the qualitative interviews conducted, a total of 5 respondents were selected for in-depth interviews. The interviews revealed deeper issues on climatic changes and the

management of NTFPs from an institutional point of view. At various points during discussion, documentary evidences were used to support the views expressed by interviewees.

3.2.5 Sampling Technique

The study adopted the multi-stage sampling technique due to the heterogeneous nature of the study area in order to give fair representation to all households in selected communities. The study at the first stage selected 4 communities including Tolibri, Berwong, Kanpouh and Oribili. These study areas were selected based on the fact that, they were major NTFP collection communities in the Lawra district as confirmed by reports retrieved from the District assembly and traditional council. Also, during reconnaissance survey, attempts were made to ask randomly on the views of people in the capital on communities where NTFP collection was prevalent. The selected four communities featured strongly again in the responses.

The second stage of the sampling involved the division of the town into various clusters due to the scattered nature of most households. Within each of the four communities, there were 3 major block divisions using landmarks such as roads, market areas, schools and religious buildings. These divisions assisted the researcher in a rather representative population for the questionnaire administration.

Further, the study at the next stage used the systematic sampling technique to reach out to households in the selected communities. The research through a diagonal walk through each block division estimated the number of houses. This provided a sample frame that was further used to determine the number of households to be selected within each block using the systematic sampling technique. The same technique was applied throughout each block.

At the final stage, household heads were selected purposively to respond to the questionnaires. However, in the absence of the household head, either the mother of the house or elderly persons available are requested to respond to the questionnaire. Also, the researcher used the Geographic Information System data collector software designed based on various attributes on the locations of NTFPs in the study areas selected. The attributes among other included spatial coordinates, sampling points, major NTFPs and other attributes (land nature, concentration types, and location of most abundant NTFPs). To aid the process of spatial data collection, the researchers adopted transect walk and critical observation techniques to confirm descriptions offered by the tour guides and field assistants.Again, in the conduct of the in-depth interviews with key stakeholders including the Environmental Protection Agency (EPA), Forest Service Division (FSD), Ministry of Food and Agriculture (MOFA), District Assembly (DA) and Non-Governmental Organizations (NGOs), the study used the purposive sampling technique in reaching out to these stakeholders. This technique however was adopted as the researcher was looking for specific information on the changes in climatic conditions as well as the collection and management of NTFPs in the Lawra district.

Finally, the study also conducted focus group discussions with selected community members. In all a total of 8 focus group discussions were made from the four communities (at least two from each community). Taking into consideration the decision making and cultures the two groups created in each of the communities had the sexes separated. This was deliberately done to allow especially women to be able to fully express themselves and not be suppressed by their counterpart men in whose presence they cannot express themselves.

3.2.6 Data Analysis

At the data analysis stage, both qualitative and quantitative data will be separately analyzed and later joined at the discussion stage. The quantitative data collected through questionnaires will be analyzed using the Statistical package for social sciences (SPSS V. 20). Various frequency tables will be generated from the data set. Also, various statistical tests were performed to indicate the relationships existing among variables. The tests conducted included cross tabulations, chi-square test of independence, correlations and regressions. These statistical tools allowed for the testing of some hypothesis and statements in literature that need further studies to confirm or deny them. The final results from the SPSS were however represented in graphical forms such as bar and histograms, pie charts and tables.

Again, all interviews conducted (Key informant and focus group discussions) were transcribed manually onto paper from audio recordings. The transcripts were then used to generate a matrix for the purposes of analysis. The matrix shows various themes generated through the objectives of the study against the 4 locations. The individual responses were then captured under each of the broad themes representing the objectives of the study. These themes generated were used to support the quantitative results of the study.

CHAPTER FOUR

RESULTS

4.1 Introduction

The chapter presents the results of the study, i.e., specifically examines the socio-economic characteristics of respondents, climate change perceptions and its effects on livelihood activities, perceptions on the availability and usage of NTFPs, identifying NTFPs and its spatial distribution, the uses of NTFPs and contribution to household livelihoods and the valuation of traded and non-traded NTFPs. The chapter also presents the results on the local management strategies used in the Lawra District to ensure the conservation and availability of NTFPs, the challenges confronting the management and uses of NTFPs with focus on the experiences of local farmers and institutions who work hand in hand in ensuring that NTFPs and their ecosystems are conserved and protected for maximum benefits.

4.2 Socio-Economic Characteristics of Respondents

Majority of respondents were females. From Table 4.1, male population is lower (38.4%) than the female population (65.2%). The wide variation in the male and female population is reflected in the population distribution at the District level. The 2010 population census of the Lawra District reveals that female population constituted 52 percent while that of male accounted for 48 percent of the total population. The population of the Lawra District is also noted to be highly youthful with the active population making about 48 percent and the dependency population constituting about 52 percent. The Table 4.1 reveals that the majority of respondents were between the ages of 31-40 years (37.4%).Those in the age cohort of 20-25 constituted (23.9%) and 41-50 years making up 23.7 percent of respondents. The varied age cohorts however added

to the richness of responses received. The experiences with climate change and its effects on NTFPs in the Lawra District were in-depth as different age groups provided unique responses over their period of stay in their respective communities.

Table 4.1: Bio Data of Respondents

variable	Freq. (%)	Variable	Freq. (%)
Sex		Religion	
Male	54 (38.4)	Christian	101 (65.2)
Female	101 (65.2)	Islam	6 (3.9)
		Traditional	48 (31)
Age		Length of Stay	
20-25	37 (23.9)	Less than 5years	2 (1.3)
26-30	2 (1.3)	5-10 years	24 (15.5)
31-40	58 (37.4)	11-20 years	27 (17.4)
41-50	37 (23.9)	21-30 years	57 (36.8)
51-60	21 (13.5)	Above 30 years	45 (29)
Household Size			
1-5	38 (24.5)		
6-10	86 (55.5)		
11 and above	31 (20)		

Source: Field Data, 2017

The size of households of respondents was assessed to provide background to the demand and pressure on household heads and families in their management strategies adopted. More than half of the total respondents had an average household size of about 6-10 members (55.5%), with. 1-5 members and above 10 members constituting 24.5 and 20 percent, respectively.

The size of the households will have significant effect on the access to and distribution of household resources. Majority of households had a size between 6-10 members, which is either equal or above the District average of 6 persons per household (GSS, 2010).

Majority of households were made up of Christians (65.2%), followed by traditionalists at 31 percent of the population. Islam however accounted for only 3.9 percent of the population (See Table 4.1). The findings of the study relates with the District level data which shows that Christians dominate the population (61%), and traditionalists (26.3%) and Islam make up only 6.6 percent of population (GSS, 2010).

Again, respondents had stayed between 21-30 years (36.8%) and over 30 years (29%) in their respective communities. Those who stayed in the community between 5-10 years and 11-20 years accounted for 15.5 and 17.4 percent, respectively. However, only 1.3 percent of respondents spent less than 5 years in their respective communities. The length of stay of respondents in their respective communities fundamentally contributed to the richness in their experiences of the changing climatic conditions and the effect on the use and availability of NTFPs in the Lawra District.

4.3 Perceptions on Climate Change and its Effects on Livelihood Activities

Climate plays a major role in communities whose livelihoods are dependent on climate related factors including rainfall and temperature. Changing climatic conditions therefore will have direct implications for local people's livelihood sustainability. The perceptions of local people in the Lawra District on climate change were assessed to determine their views and experiences, which are vital in any effort to mitigate the effects of climate change. The study first established that all respondents had awareness of the climate change phenomenon.

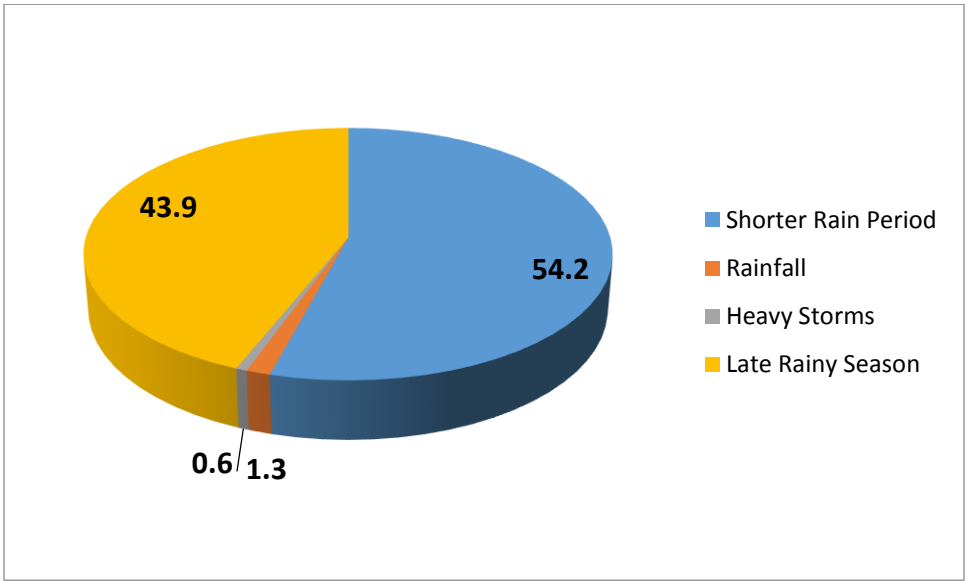


Figure 4.1: Perceptions on Rainfall Pattern

Source: Field Data, 2017

They indicated the various ways they perceived climate change over the years. Figure 4.1, shows that the majority of residents noted that the pattern of rainfall had changed over the years. Key among their observations is that the rainfall period had become shorter (54.2%) over the years and others confirmed that the rains arrived very late in recent years (43.9%) and highly unpredictable. The remaining 1.3 percent and 0.6 percent observed heavy rainfall and heavy

storms as changes in the recent past. They noted that the unpredictable and short rainfall period had affected their farming activities.

During focus group discussions at Oribili, a 68 years old farmer noted that,

> *"we have observed so many changes over the last 15 years or so. Rainfall patterns have become so uncertain, shorter durations, heavy winds and storms that used not to be the case. Is this not the climate change?"*

Similar views were expressed across all study communities on the signs and changing patterns in rainfall regimes.

Residents view on temperature changes over the years also affirms their awareness of climate change. Nearly all residents (99.4%) stated that temperature conditions over the recent past had followed a rising trend and becoming unbearable. However, 0.6 percent of the population noted that temperatures were rather decreasing. The Focus group discussions confirmed the views of the people on temperature rise. The participants in the discussion were certain that temperature had not decreased at any point in time and that the heat produced in recent times was getting so unbearable. A female participant expressed her view on temperature rise, noting that,

> *"Temperature has risen and is having severe and unbearable effect on us, our activities and everything we do. This days before you are up from bed the sun has already shown up in the sky. By mid-morning we now begin greeting each other good afternoon, thinking the day is far gone due to the heat. This has been the situation over some years now and it doesn't look reversing in the shortest possible time"*

There was a quick reaction however to the concluding statement of the previous speaker from a young farmer, who indicated that,

> *"Not in the shortest possible time, probably forever, since all the things we do now is what is responsible for the situation. If we don't change, the situation will become worse than now"*

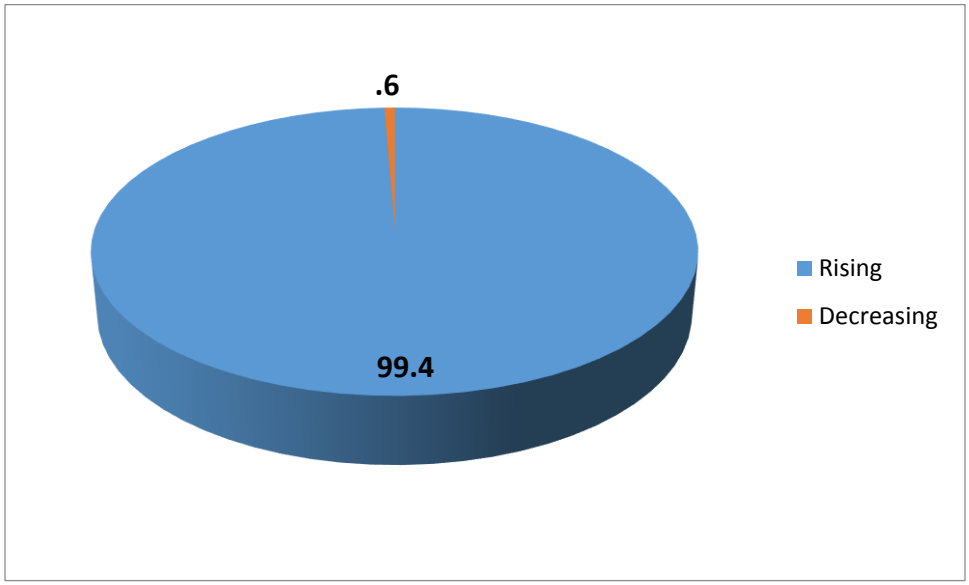


Figure 4.2: Perceptions on Temperature Changes

Source: Field Data, 2017

4.3.1 General Rainfall and Temperature Distribution in the Lawra District

The Figure 4.3 shows the rainfall pattern for the last 30 years in the Lawra District. Generally, the rainfall pattern has continuously fluctuated for the period between 1984 and 2014. Rainfall amounts have dwindled greatly over the last 30 years with peak points recorded over few years. Many years over the period have rather experienced decreased rainfall. Since 1984 rainfall peak years were recorded in 1986 (97.77mm), 1995 (105.18 mm) and the highest amount received in

2008 (107 mm). Rainfall amounts have generally decreased between the peak years. Since the last peak period in 2008, there have been a decline in rainfall till 2014 in which the minimum value of 78.08 mm was recorded.

The rainfall in the Lawra District has been fluctuating greatly over the entire 30 years period even though the recent years have recorded lower values, showing a decreasing pattern of rainfall. However, over the 30 year period, the mean rainfall value was 85.3mm. The minimum and maximum values over the same period were 58.36 mm and 107 mm respectively.

The data provided supports the views of residents in the study areas who noted that rainfall patterns have remained highly unpredictable, declining and shorter periods of rain over the last decade. With declining and unpredictable patterns of rainfall, the traditional livelihood of residents in the Lawra District is affected with many looking for alternative sources to support and complement household livelihood demands for sustainable growth. The gradient of the slope is given by the formula y=mx +C where y refers to the rainfall amount and x indicating time (years). The rainfall graph (figure 4.3) showed that from 1984-2014 rainfall decreased at a rate of 0.7637mm annually. The R^2 value of 0.16% only indicates the variations explained in the trend in rainfall over the period leaving the greater portions of the variations observed to other factors rather than time. A likely factor responsible for this variation could be the increasing climate change patterns observed in the area.

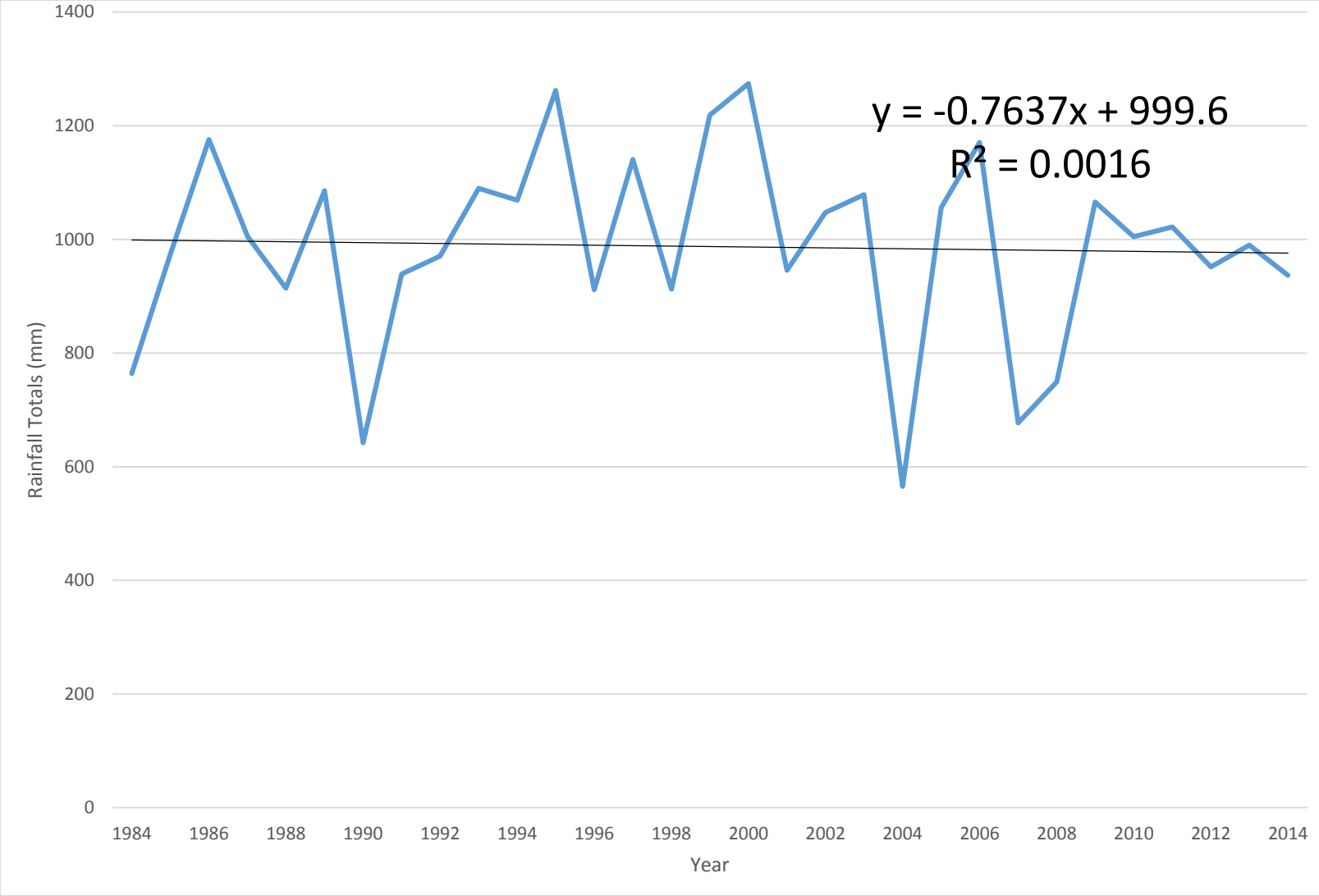


Figure 4.3: Rainfall Graph of the Lawra District (1984-2014)

Source: GMet, 2017

Temperature patterns in the Lawra District for the periods spanning 1984 -2014 (30 years) were also analyzed (Figure 4.4). Data was however not available for certain periods in the 30 years span, i.e.1986-1987, 2005-2006 and 2008.

Temperature in the Lawra District in recent times therefore has increased, confirming earlier observations made by residents of the study areas who stated that temperatures continue to rise over the period and has some impacts on their productivity. The past 30 years under study has shown a steady increase in temperature. The maximum temperature recorded was in 1996 31˚C with the lowest figure of 25˚C recorded in 2007. The district since 2007 has seen continual increase in temperature above 29˚C in most years reaching its second highest at 30.1˚C over the period.

The temperature graph (figure 4.4) showed that from 1984-2014 temperature decreased at a rate of 0.0127mm annually. The graph indicates that only 1.19% (R^2) of the variations in the amounts of rainfall over the period is explained by the variations in time. The differences in rainfall over the period are therefore caused by other factors rather than time. Again the likely factor responsible for this variation could be the increasing climate change patterns observed in the area.

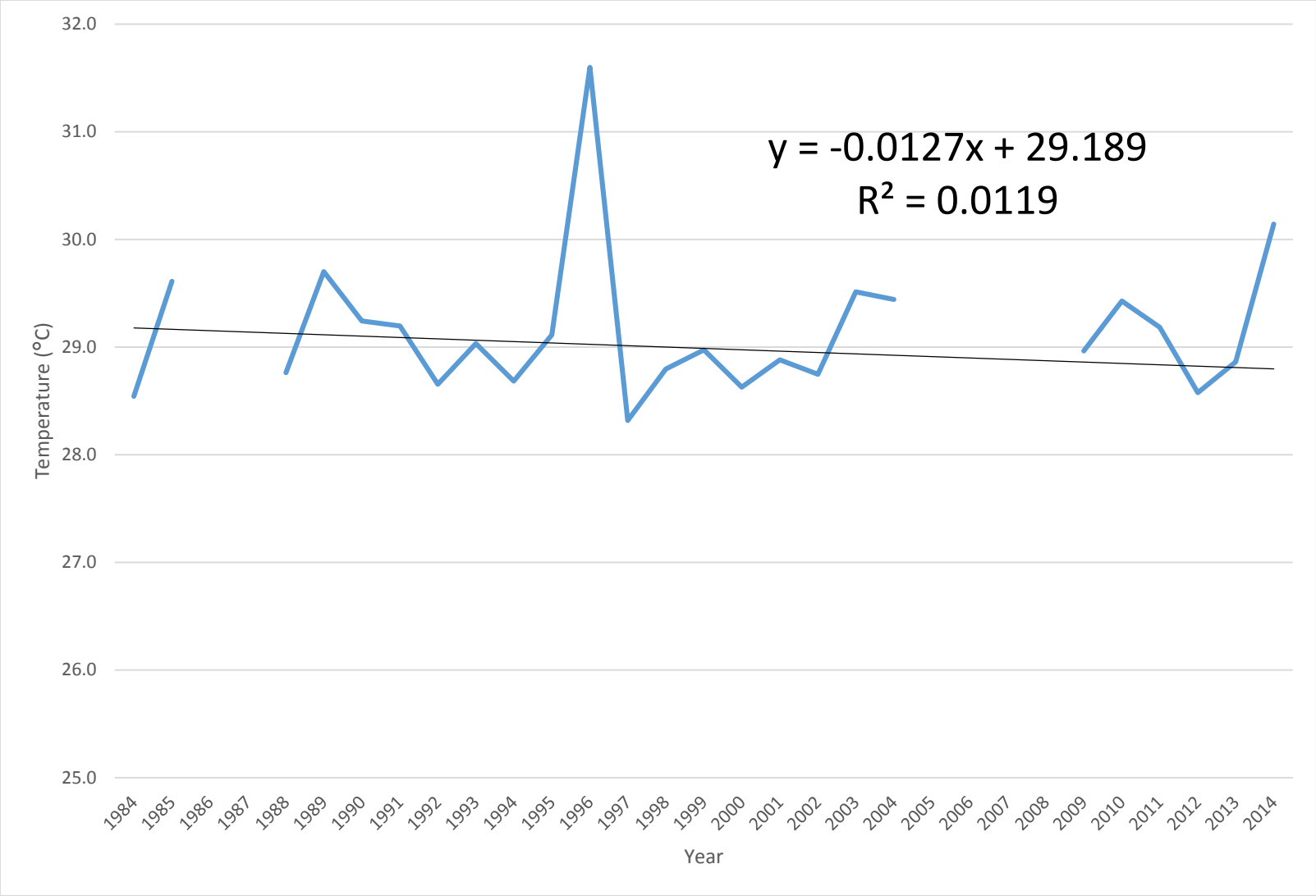


Figure 4.4: Temperature Distribution in the Lawra District (1984-2014)

Source: GMet, 2017

4.3.2 Perceptions on the Causes and Effects of Climate Change on Livelihoods

The views of local residents on the causes of climate change were assessed. There were varied views expressed by respondents with majority noting that the major causes were poor agricultural practices, bush burning (23.9%) and cutting down of trees (18.7%). Other factors included natural phenomenon, (18.1%) as well as Gods reaction to human sin (9%) (Figure 4.5).

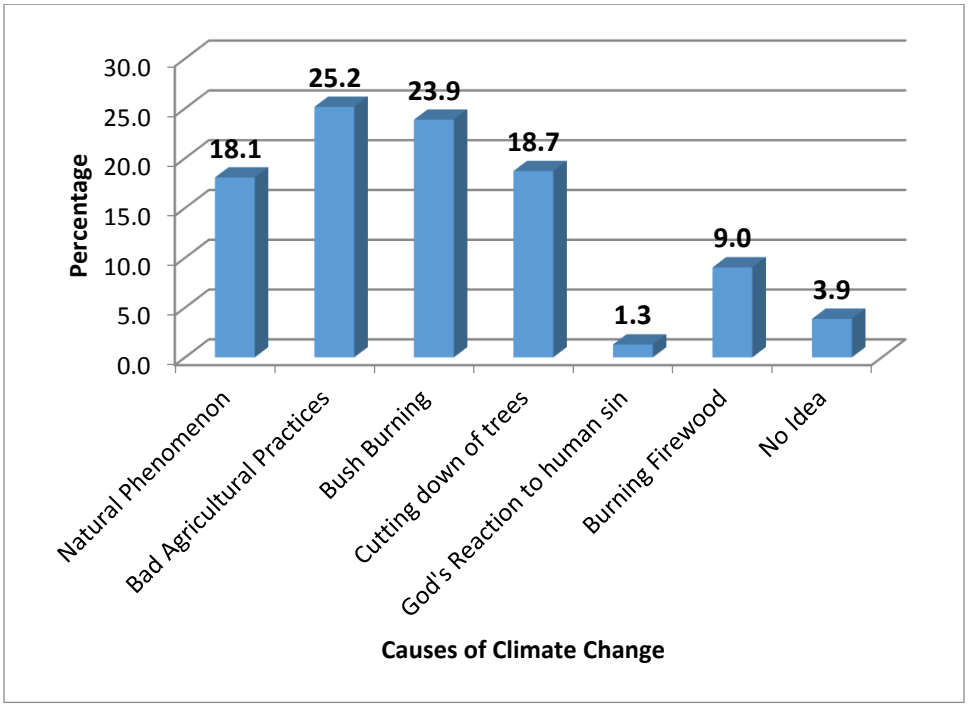


Figure 4.5: Causes of Climate Change

Source: Field Data, 2017

The views of respondents on the effects of climate change on livelihood activities in the Lawra District were also assessed. Majority of the respondents indicated that the major effect of climate change was the reduction in harvest of crops as agriculture remains the major livelihood activity.

They indicated that the total yields from their farms had declined continually over the past years and in certain cases, farmers do not substantially gain from the farms.

At Oribili, during FGDs, a farmer recounted some of the effects of climate change on the livelihood of his household. He stated that,

> *"low crop yields, destruction of NTFPs, damages to houses are some of the effects of climate change on the livelihood activities of my family"*

Similarly in Berwong community during a focus group discussion, a 63 years old farmer indicated that,

> *"Climate change affects our crop and animal production as well as some of the NTFPs in the bush".*

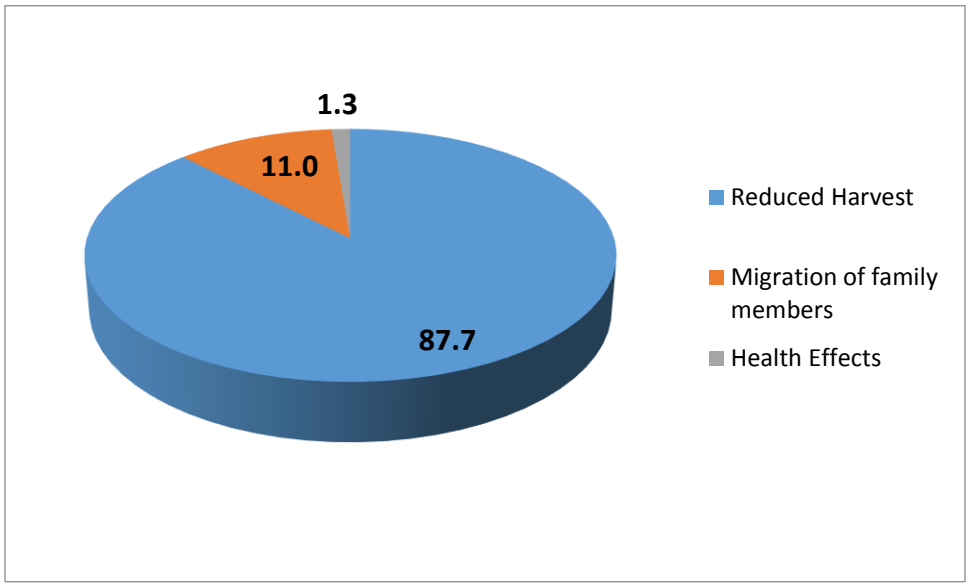


Figure 4.6: Effects of Climate Change on Livelihood Activities

Source: Field Data, 2017

4.3.3 Adaptation Strategies by Local Populations

Respondents in all study communities noted that climate change had affected their major source of livelihood, farming, mostly in the form of reduced farm yields and this was having significant effect on their families. The study also examined the adaptation strategies used by the residents to cope with the climate change effects. Majority of the respondents who are farmers noted that to adapt to the changing climate condition, they engaged in various strategies to support family livelihood demands of which NTFP collection (39.4%) has become a vital sector.

A 56 years old farmer explaining the shift to the use of NTFPs in the District noted that,

> *"NTFPs have always been available but many people were not interested since farming was doing ok, but now several types of NTFPs are being collected on daily and seasonal basis either for sale or to be used by families as food supplements"*

During the focus group discussions, 38 years old female Trader noted that

> *"On daily basis I try to get some form of NTFPs to sell, I do go and collect dawadawa and shea nuts myself and I also buy and sell again. This I have been doing for the past 3 years. My husband decided that I should do this whiles he also try to focus on agriculture. At the end, the NTFPs supports us on a daily basis before the farm yields comes in"*

A total of 25.2 percent of residents identified trading and business as other adaptation strategies. They noted that trades such as carvings, petty trading, weaving and also 'by-day' (daily wage works) works were also used to support farming returns. Other strategies included, reducing negative environmental practices (17.4%), use of fertilizers and improved seedlings (9.7%), fertilizer use (7.7%) and storing food for the lean period (0.6%).

During FGDs, most of the residents engaged in more than one of these adaptation strategies since there is much demand to foster growth in the family. Notwithstanding the multiple sources of deriving income, it was also reported that adaptation strategies in certain cases was a household affair. The household is deliberately divided into groups to engage in specific types of activities so us to ensure some cash is drawn from every opportunity available.

The low response to irrigation is due to the fact that, only Oribili among the study communities, was close to the White Volta where some farmers engaged in irrigation for the production of vegetables mainly. According to the 'Tindana' (Chief Priest) of the Oribili,

> *"The community adopts adaptation strategies such as, dry season farming of vegetables (okra, onion, pepper, garden eggs, carrot, tomatoes, cassava leaves etc.) along the White Volta which we here are blessed with. Most of the other communities are so far away from this water resource and so do not have access".*

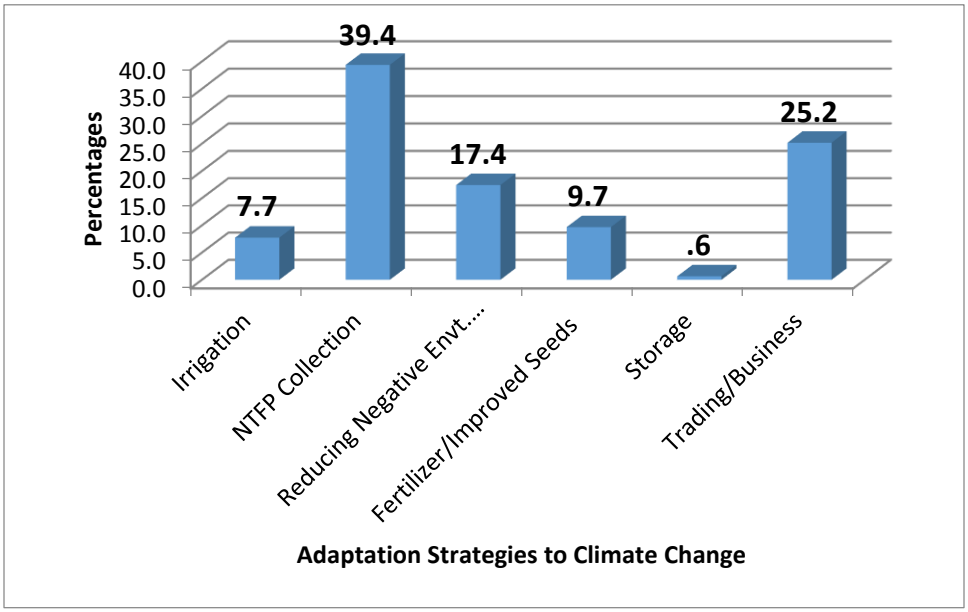


Figure 4.7: Adaptation Strategies to Climate Change

Source: Field Data, 2017

A cross tabulation assessed respondents' residence and the adaptation strategies adopted to climate change, but did not show variations at the community level (Table 4.2). Resident's decision to engage in the collection of NTFPs cut across all four communities. Apart from NTFPs collection, the adoption of other strategies was slightly varied among the different communities.

In Tolibri majority of the respondents indicated the collection of NTFPs (43.6%) as an adaptation strategy. Other key strategies adopted in Tolibri includes the use of fertilizers and improved seeds (20.5%), reducing negative environmental impacts (15.4%) as well as trading/business (10.3%). Again, some 5.6 percent and 4.7 percent of respondents engage in storage and irrigation strategies respectively. In Berwong, 43.6 percent of respondents engage in the collection of NTFPs, 23.1 percent in reducing negative environmental impacts and another 20.5 percent in trading and business. In Kanpouh the collection of NTFPs again dominates with 64.9 percent. Trading and business as well reducing negative environmental impacts constituted 18.9% and 13.5 percent respectively in Kanpouh. It is worth noting however that, the first three communities benefit from a project scheme targeted at protecting and conserving the environment. The environmental restoration and conservation project led by a number of NGOs as well as the District Assembly does not cover Oribili, necessitating that they institute their own environmental conservation methods.

In Oribili, the collection of NTFPs still is the major adaptation strategy to climate change (42.5%). Reducing negative environmental impacts, use of fertilizers and improved seeds as wells trading and business recorded 15.5 percent, 15 percent and 15 percent respectively. In

Oribiri, 10 percent of respondents indicated irrigation as an adaptation strategy. Unlike all other three communities where irrigation is not a critical strategy due to the absence of water body (few dug out wells), Oribili stands out with its location close to the White Volta.

Table 4.2: Cross Tabulation: Community * Adaptation Strategies

	Irrigation	NTFPs Collection	Reducing Neg. Envt. Impacts	Use of Fertilizers and improved seeds	Storage	Trading/business
Tolibri	4.7	43.6	15.4	20.5	5.6	10.3
Berwong	3.3	43.6	23.1	2.6	7	20.5
Kanpouh	0.7	64.9	13.5	1	1	18.9
Oribili	10	42.5	15.5	15	2	15

Source: Field Data, 2017

A correlation test between the community of residence of respondents and the adoption of adaptation strategies to climate change was calculated. The test reveals that the correlation between the two variables stood at -0.009. The value shows a strong negative correlation between the two variables. This implies that there is a strong inverse relation that indicates that as one variable increases the other reduces. The community of respondent correlates with changing adaptation strategies to climate change. However, the test again indicates that the significance of this strong negative correlation between community and adaptation strategy to climate change is insignificant (0.909 > 0.05). This further shows that the community of resident

of respondents is independent of the adaptation strategies adopted to climate change mitigation (See Table 4.3)

Table 4.3: Correlation: Community * Adaptation Strategies to Climate Change

Correlations		Community Name	Adaptation Strategies
Community Name	Pearson Correlation	1	-.009
	Sig. (2-tailed)		.909
	N	155	155
Adaptation Strategies	Pearson Correlation	-.009	1
	Sig. (2-tailed)	.909	
	N	155	155

Source: Field Data, 2017

4.4 Perceptions on the Availability and Usage of NTFPs

The availability of NTFPs was assessed to ascertain whether NTFPs were increasingly becoming available to households or decreasing. Table 4.8 shows that residents in the study communities emphatically noted that NTFPs in their communities has seen an increase (81.3%) in availability while 18.1 percent do not see any increase in the availability of NTFPs. The increase in the availability of NTFPs is mostly as result of the increased awareness on the potentials of NTFPs quite recently. Hitherto, only few people were engaged in the collection with lots of the plants especially left in the wild. But now there are deliberate attempts by families to protect lands to have access to NTFPs for harvest. NTFPs have become increasingly common both in the bush

and around homes due to the increase awareness and potentials that has led to stronger family and community protection strategies.

According to a Tindana at Oribili,

> *"There is increase availability of NTFPs in the bush and around homes and because of the shift to harvest of such resources; people do all manner of things to protect their lands with NTFPs from other people harvesting them. But such NTFPs as baobab and shea are more a common and community resource"*

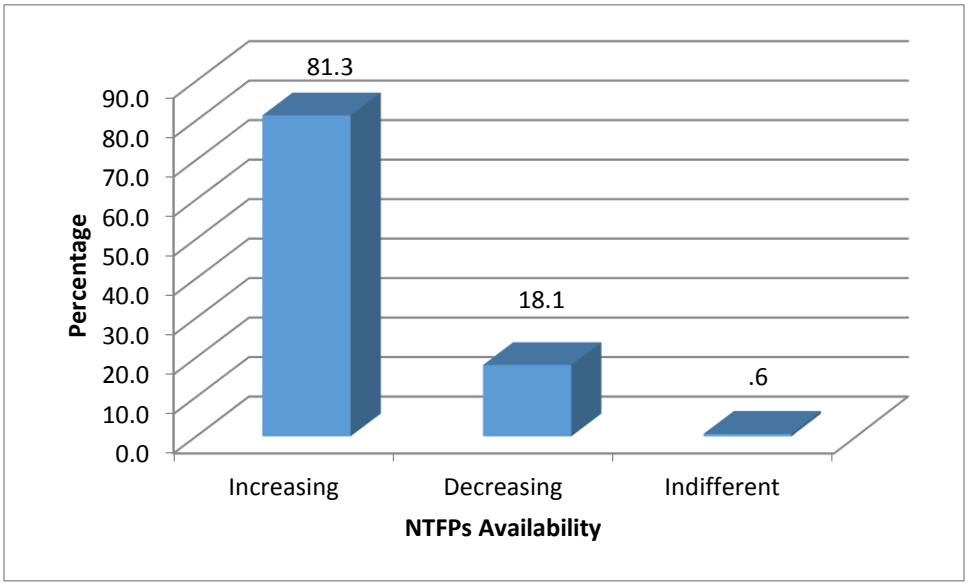


Figure 4.8: Availability of NTFPs

Source: Field Data, 2017

The study also examined the community variations in the availability of NTFPs. It is revealed that all communities indicated an increase in the availability of NTFPs. In Tolibri and Berwong, over 84 percent of respondents noted that NTFPs have increased over the years. In Kanpouh however all respondents (100%) observed an increase in NTFPs. The case of Oribili is however

unique as responses were quite close in nature, as a total of 57 percent (114) of respondents noted an increase in NTFPs whereas over 40 percent of them observed a decrease (see figure 4.9)

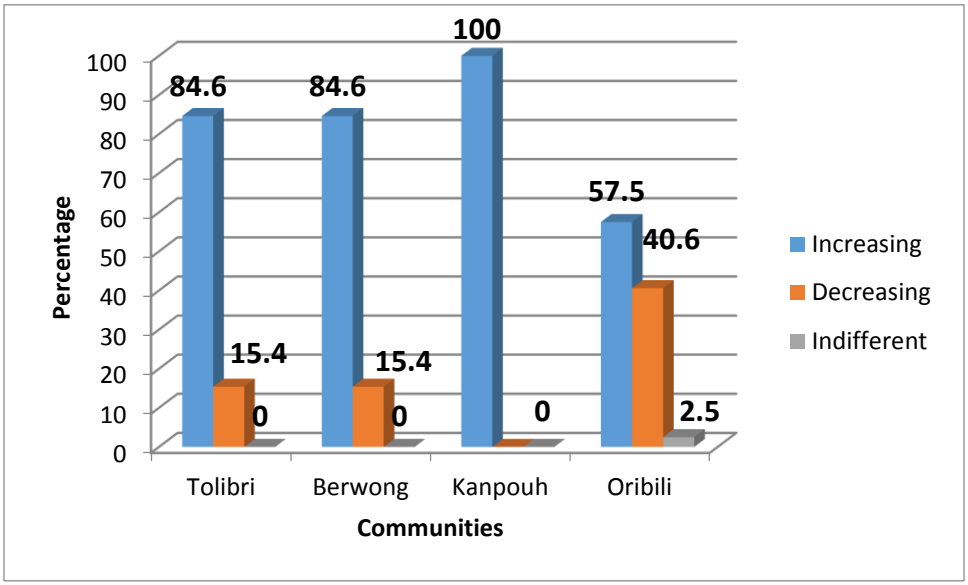


Figure 4.9: Cross Tabulation: Community * NTFP Availability

Source: Field Data, 2017

The level of correlation between the community of residence and the availability of NTFPs in the Lawra District was measured. Table 4.4 shows that the correlation between the two variables (.208) is a positively weak correlation as the value approaches zero (0) which shows no correlation. Although, there is a positive weak correlation between the variables, the level significance indicates that the correlation between community of residence and the availability of NTFPs is significant at .010. This reveals that the availability of NTFPs relies on the community of residence. NTFPs however are perceived to be increasing across all study communities and the variations in this increase are dependent on the community's environmental practices as well as the concerns on protecting and conserving NTFPs. The study therefore has established that,

NTFPs availability is increasing across all communities and its sustainability is further dependent on a myriad of factors including changes in temperature and rainfall conditions.

Table 4.4: Correlation: Community of Residence * Availability of NTFPs

Correlation		Community of Residence	Availability of NTFPs
Community	Pearson Correlation	1	.208
	Sig. (2-tailed)		0.010
	N	155	155
	Pearson Correlations	.208	1
Availability of NTFPs	Sig. (2-tailed)	0.010	
	N	155	155

Source: Field Data, 2017

The study sought to explore NTFPs as a sustainable adaptation strategy used by communities in mitigating the effects and impacts of climate change on community livelihoods. In doing so, there is the need to establish that NTFPs availability is sustainable with or without changes in climate conditions. This will make local residents shift to the harvesting of NTFPs in periods of poor farming yields due to unconducive climate conditions. Two different regression model test is set up to ascertain whether climate is a predictor of the availability of NTFPs. Climate factors (Rainfall and Temperature) were used as predictor variables (independent) against NTFP

availability which is the outcome variable (dependent). The test results are shown in Tables 4.5 and 4.6.

From table 4.5 which shows the regression model results for NTFP availability and rainfall, the coefficient table reveals that the correlation between NTFP availability and changes in rainfall is 0.008 as shown in standardized coefficient (Beta) value session. The result indicates a positive weak correlation between the two variables as the r =0.008 approaches zero (0). Also, the unstandardized coefficient (B) shows that variations in rainfall pattern will lead to only 0.002 changes in the availability of NTFPs. Further, the significance of the model is shown in the Sig. column which shows that the P-value of 0.923 is not significant. In other words, the availability of NTFPs is not dependent on the changes in rainfall conditions.

Secondly, the regression model for temperature changes and NTFP availability is also set up to examine the relationship between the two. The regression table of coefficient (table 4.6), the standardized coefficient (Beta) value of -0.038 show a negative weak correlation between the availability of NTFPs and temperature changes. It also shows a weak inverse relation between the variables, indicating that as one variable gets larger the other gets smaller. However, this inverse relation is a weak one with the value (-0.38) approaches zero. Again, the model holds that there is a statistically insignificant relation between the availability of NTFPs and temperature changes as indicated by the test result of 0.639. This also clearly shows that changes in temperature have very insignificant effect on the availability of NTFPs in the Lawra District.

The combined results however indicate that climate change is a poor predictor of NTFPs availability in the Lawra District. This makes a strong case for NTFPs as a probable alternative

to communities as a household income source. The continual reliance of communities in the Lawra District on climate dependent livelihood activities (agriculture) makes them vulnerable in periods of reduced farm yields due to unfavorable climate. This vulnerability exposes them to several livelihood risks including poverty and food insecurity. With climate change having insignificant effects on the availability of NTFPs, it offers a source of opportunity to local people to complement and support household food, income and medicinal needs.

Table 4.5: Coefficients- Availability of NTFPs * Observed Changes in Rainfall

Regression Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	1.188	.062		19.091	.000
Observed Changes in Rainfall	.002	.022	.008	.097	.923

a. Dependent Variable: Availability of NTFPs

Table 4.6: Coefficient – Availability of NTFPs * Changes in Temperature Conditions

Regression Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B+	Std. Error	Beta		
1 (Constant)	1.390	.419		3.318	.001
Changes in Temperature Conditions	-.195	.415	-.038	-.470	.639

a. Dependent Variable: Availability of NTFPs

4.5 Identifying NTFPs in the Lawra District

The study sought to identify as many as possible all the available and used NTFPs in the Lawra District paying particular attention to uncommon NTFPs identified. This was done through extensive field survey with respondents that involved in certain cases, taking samples from the bush to establish differences and availability of such products in the area. A long list is provided in the table below while the study provided some description on the most commonly used and available ones. All available types of NTFPs that are found in the communities and that are commonly used, as identified through focus group discussions (FGD), were aggregated and compiled (Table 4.7). NTFPs identified for each specific community are listed in Appendix II. Scientific names of the identified NTFPs are also provided. The scientific names assist interested researchers and the wider research community to acknowledge the variations among the NTFPs from one community to another. The study also received a comprehensive list of NTFPs in the entire Lawra District from the Lawra District Assembly (see Appendix III).

Various communities were asked to identify the most commonly used and available NTFPs around them (See Appendix II for comprehensive NTFPs list in each community). Five major NTFPs harvested across the four study communities were not unique to each of the communities. In addition to the commonly known NTFPs, i.e., the shea tree, baobab and dawadawa, there were about 75 NTFPs identified in the communities. Table 4.7provides a serial number (S/N), local names and scientific names for each plant NTFP identified. Table 4.7a indicates plant NTFPs with no scientific name identified in study communities. In some cases, the scientific names of the plants were unknown and need to be further investigated. There are also faunal NTFPs listed

in the table 4.7b. A total of 78 NTFPs are listed which include plant and animal NTFPs that are used at varied frequencies.

Table 4.7: Plant NTFPs in Study Communities

S/N	LOCAL NAMES	SCIENTIFIC NAMES
1	Taame	*Vitellaria paradoxa*
2	Dooro	*Parkia biglobosa*
3	Suge/ Suga	*Lannea acida*
4	Ore	*Physalis peruviana*
5	Gaa	*Diospyros crassiflora*
6	Kazuge	*Gardenia ternifolia*
7	Tokpara/Tou-tee	*Adansonia digitata*
8	Goue	*Ceiba pentamdra*
9	Kalezur	*Gardenia temitolia*
10	Gogoh	*Acacia nilotica*
11	Gozang	*Acacia albida*
12	Gopula	*Acacia sp*
13	Golezie	*Acacia hockii*
14	Kakala	*Afzelia africana*
15	Kakyelleh	*Danniella oliveri*
16	Ob-nyukuo/zangala	*Moringa oleifera*
17	Kakang	*Ficus anaphelocerfa*
18	Kakankyikya	*Ficus capensis*
19	Kyira	*Blighia sapida*
20	Vega	*Bambox bounopezense*
21	Kpagra	*Detarium microcarpum*
22	Goue	*Acacia nilotica*
23	Saal-tie	*Burkea africana*
24	Seetug-le	*Lannea barteri*
25	Susug-le	*Lannea acacia*
26	Togbo	*Cardiac senegalensis*
27	Kpagra	*Deterium microcarpum*
28	Lieme	*Ximema americana*
29	Gbongkira	*Ceiba pentandra*
30	Sansan	*Balanites aegygyptiaca*
31	Veega	*Bambox costatum*
32	Puretia	*Tamarindus indica*
33	Bere	*Hibiscus esculentus*

Source: Field Data, 2017

Table 4.7a Plant NTFPs with no Scientific Names

34	Gbeme	52	Ben-ora
35	Swaka	53	Bang-na
36	Gyamgboro	54	Aara
37	Torvaar	55	Vaar
38	Kolemakou/poukale	56	Kalgbog-la
39	Baarigbe	57	Mgbeme
40	Dunkum	58	Dakune
41	Gbaara	59	Naapuro
42	Tuvaa	60	Youvaa
43	Bere	61	Nmaaasugeh
44	Gyangboro	62	Nminmiirakoler
45	Popong	63	Mgmene
46	Koko	64	Malere
47	Saalupela	50	Baa-ore
48	Saalung lellaa	51	Ang-a
49	Segboro	52	Ben-ora
50	Baa-ore	53	Bang-na
51	Ang-a		

Source: Field Data, 2017

Table 4.7b Animal NTFPs in Study Communities

S/N	**LOCAL NAMES**
1	Onsagra
2	Kur
3	Kyera
4	Zupon
5	Derbaa
6	Ong
7	Kure
8	Woula
9	Song
10	Sansire
11	Korenye
12	Derbaa
13	Kyei
14	Mhaare

Source: Field Data, 2017

Table 4.8 show the five most harvested NTFPs in each study community. The arrangement however is not in any order of importance.

Table 4.8: Five Major NTFPs Harvested

Community	1	2	3	4	5
Oribili	Baobab	Shea tree	Dawadawa	Yellow berry	Suge
Kanpouh	Shea tree	Dawadawa	Baobab	Suge	Kazuge
Brewong	Dawadawa	Shea tree	Baobab	Moringa	Sansan
Tolibri	Dawadawa	Shea tree	Moringa	Yellow berry	Suge

Source: Field Data, 2017

Plate 1: Dawadawa Fruit Eaten Directly from Wild

Source: Field Data, 2017

Plate 2: Shea Nut sold at Lawra Market

Source: Field Data, 2017

Plate 3: Freshly Harvested Baobab Fruit

Source: Field Data, 2017

Plate 4: Processed Baobab Leaves for Soup Preparation (Spice)

Source: Field Data, 2017

4.6 Spatial Distribution of NTFPs in the Lawra District

The distribution of NTFPs in the Lawra District does not follow any observable pattern. NTFPs are spatially distributed across the whole District. They are mostly located in the open bushes, forest areas (protected and free range) and within communities. Most of the protected forest areas have a cluster of plant NTFPs and are designated as parklands. The parklands are very different from the open bushes. Both have an assemblage of the same types of NTFPs occurring in large numbers over some extended space. However, in unprotected areas (open bushes) there are mixes of NTFPs accessible by anyone. As a result, access to most of these NTFPs is unrestricted under various jurisdictions. However, there are community boundaries in the access to NTFPs. Communities are prohibited from venturing into other communities to access NTFPs. In certain cases, there are some established parklands of NTFPs that are found at borders or boundaries of two or more communities. In such situations there is a mutual agreement on access to such parklands of NTFPs.

Direct field observations (Transect walk) and oral history shows that locations of major NTFPs in the study communities form large parklands. Some the common tree species making up parklands included dawadawa, shea trees, baobab, Kazuge and yellow berry among others. The parklands were mostly located in each community, except for the dawadawa tree. The dawadawa is widely scattered across the District but major parklands were found in Kanpouh. Shea parklands were also found between Tolibri and Berwong. Baobab parklands were also found in Tolibri, Berwong and Oribili except in kanpouh.

4.7 General Uses of NTFPs

NTFPs in the Lawra District are put to various uses depending on the level of knowledge on the possible use of such resource to the community. The study observed some little variations in the uses of NTFPs across the various communities which are also influenced by availability and demand for the resource.

This was observed in Kanpouh where the baobab tree is not in abundance. The general uses of NTFPs however include food, medicine and sale (income). Most NTFPs are directly consumed in their fresh state while others are prepared over fire before consumption.

Also, most NTFPs have several parts that are useful for consumption including leaves, roots; fruits and barks of are put to several uses by households. Various methods are used in the preparation of NTFPs for its uses stated above. For medicinal purposes, some leaves and barks are dried under intense heat for hours to days before its use. The table 4.9 also shows a list of plant and animal NTFPs, the parts used as well as the uses of such plant values. Table 4.9 show a number of NTFP and their uses as well as the parts that are normally used. For plant NTFPs they mostly are used for food, medicine and as an income source. Their fruits, nuts, bark and leaves constitute the parts of the plant that is used. For animal NTFPs, the whole animal is prepared for food and also sold out for income in most cases. Not much has been revealed about animal NTFPs beyond these two uses. Also, some parts of animals in few cases are used to prepare various medicines for ailments. For example the intestines of Kyei (squirrel) are used by many local people to prepare medicine for certain ailments in the local area. Also, Kolemakou/Poukale is also used as food as well as medicine.

Table 4.9: Uses of NTFPs

NTFP	Part Used	Uses
Taame (Shea tree)	Nut, fruit, bark, root, shell and leaves	Food, medicine, spices
Dooro (Dawadawa)	Nut, fruit, bark, leaves,	Food, spices medicine
Tokpara (Baobab)	Leaves, fruits	Food, medicine, spices
Suge/Suga	Leaves, fruit	Food
Ore (Yellow Berry)	Fruit, bark	Food, medicine
Gaa (Ebony tree)	Fruit, branch sticks, wood	Food, Medicine
Kazuge	Fruit , roots	Food, medicine
Sansire (Grass Cutter)	Whole	Food, Income
Korenye (Bush Guinea Fowl)	Whole	Food, Income
Kyei (Squirrel)	Whole	Food, Income, Medicine

Source: Field Data, 2017

4.8 Contribution of NTFPs to Household Livelihoods

In all four study communities, NTFPs play a very significant role as a livelihood strategy among households. In the first instance, the study examined the perception of residents on what constitutes NTFPs. To majority of the respondents NTFPs is seen as food supplement (49.7%) with about 29.7 percent of the respondents noting NTFPs as a source of income. Equally important are the 20.6 percent of respondents who identified NTFPs as a source of medicine. In all study communities, every household is directly engaged in the gathering of one form of NTFP for various reasons to support their livelihood.

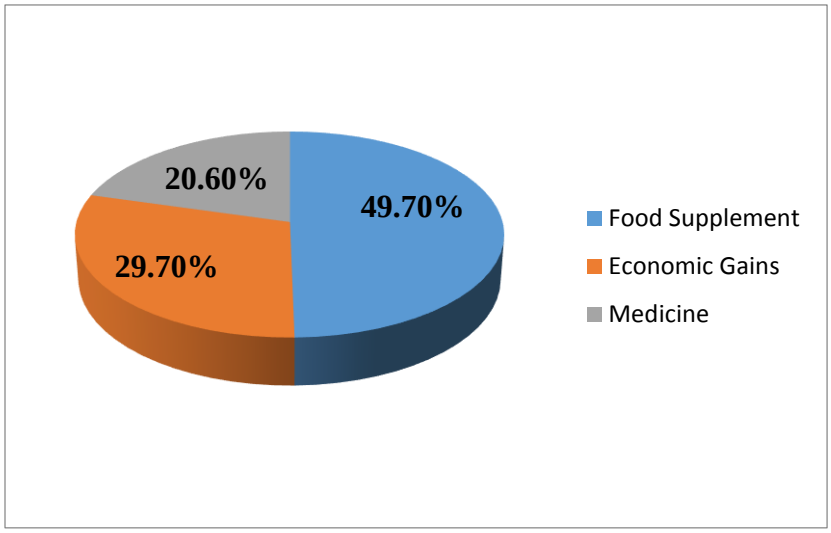


Figure 4.10: Perceptions on Role of NTFPs

Source: Field Data, 2017

The study further sought to understand whether the views expressed on the role of NTFPs varied among communities in terms of its importance. A cross tabulation and chi-square test of independence was conducted to ascertain this view. From Table 4.10, all respondents across all

four communities maintained that NTFPs were collected as a food supplement. Also, economic gains appeared the second most important reason for collecting NTFPs even though the figures changes slightly in Tolibri where, economic gains accounted for 4.5 percent and Medicine 5.8 percent.

Table 4.10: Cross Tabulation: Communities * Role of NTFPs

Community	Food Supplement	Economic Gain	Medicine
Tolibri	14.8%	4.5%	5.8%
Berwong	12.9%	8.4%	3.9%
Kanpouh	11%	8.4%	4.5%
Oribili	11%	8.4%	6..5%

Source: Field Data, 2017

Table 4.11: Correlation: Communities * Role of NTFPs

Correlations		Community	Role of NTFPs
Community Name	Pearson Correlation	1	.092
	Sig. (-2tailed)		.255
	N	155	155
Role of NTFPs	Pearson Correlation	.092	1
	Sig. (2-tailed)	.255	
	N	155	155

Source: Field Data, 2017

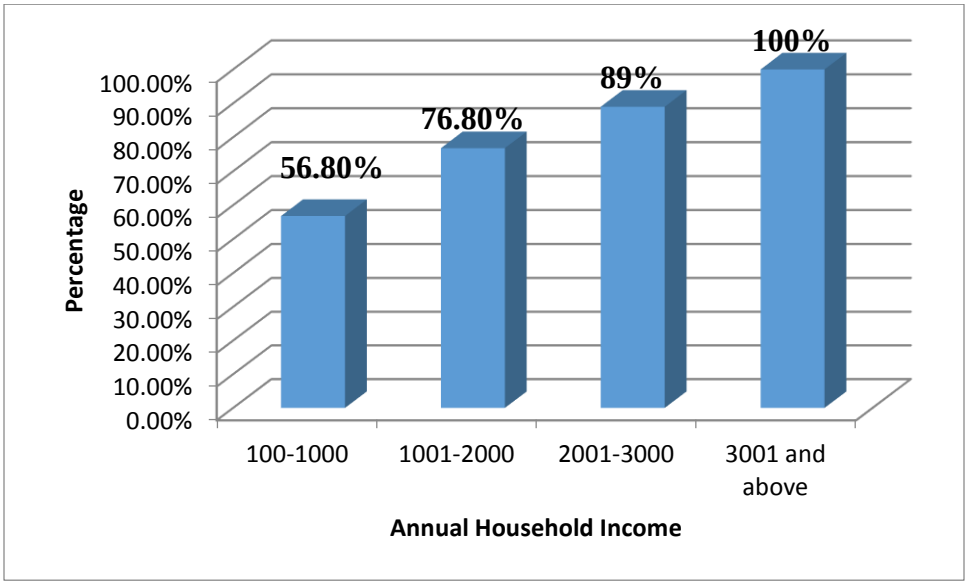
That notwithstanding the correlation results for community of residents and respondents perceived role of NTFPs reveal a correlation of .092 (r) which shows a strong positive correlation between the two variables as (0.092(r) approaches 1). Despite the strong correlation between community of residence and perceived role of NTFPs, the table again reveals that the correlation is not significant (.255 > 0.05). In other words the test reveals that the perceived role of NTFPs does not depend on the community of residence (table 4.11).

4.9 Valuation of Financial Returns from Traded NTFPs

NTFPs are widely known as a valuable resource to communities who have defined varied uses for them. There are variations in what constitute an NTFP depending on the location where it is found as what is a resource varies from one location to the other. Some NTFPs are sold in the markets for cash whereas others are not traded. From focus group discussion held, most of the traded NTFPs are the common ones already known including, dawadawa, shea tree products (butter, nuts, spices etc.), baobab, kazuge and yellow berries as shown on the spatial distribution map (Figure 4.10). Apart from these traded NTFPs, the rest are not mainly sold for cash.

> *"We sell some of the NTFPs for cash like those common ones, shea nuts, dawadawa, Kazuge, baobab, yellow berries and some bush animals (meat). The rest have very limited uses and mostly in the open for anybody to harvest. Some are also taken fresh without preparing them. Those ones you don't even take to the market because no one will buy" (FGD, 53 years old, Farmer and NTFP trader, 2017)*

In the Lawra District however the collection and use of NTFPs have been seen to contribute to the income levels of households. This study therefore sought to estimate first the total annual income of the household and also the amount contributed to this income through the sale of NTFPs. The average annual income of respondents was however estimated based on respondents declared sources of income and how much each source contributes to the household income. The figure 4.11 shows variations in the average annual income of households. The figure however presents a cumulative percentage of respondents' views. Those who have a total annual household income averaging GH₵100-1000 constitute the largest population making up 56.8 percent. The second income group of GH₵ 1001-2000 constitutes approximately 20 percent of the total population. The income groups of GH₵ 2001-3000 and above GH₵ 3000 however make up 12.2 and 11 percent of the population respectively.



Mean = GH₵ 1759.48 Min = GH₵ 100 Max = GH₵ 10900

Figure 4.11: Annual Household Income of Respondents

Source: Field Data, 2017

The data however shows that those who have a total average annual household income over GH₵ 2000 rather constitute the minority of the population. However, the mean value of the average annual income stands at GH₵ 1759.48 with the minimum and maximum values at GH₵ 100 and GH₵ 10900 respectively. This has further implication on income distribution as majority of the population receives average annual income far below the mean value. This indicates however high income disparities in the household annual income.

Majority of respondents have a total annual household income less than GH₵ 1000. The Figure 4.2 shows that the income returns made from the sale of NTFPs is widely spread across households. Majority of population make between GH₵ 101-199 (23.2%) and GH₵ 300-499 cedis (21.3%) respectively. Only 7.7% and 9.0% of respondents receive below GH₵ 100 and above GH₵ 1000 cedis respectively in the lower income bracket. The data however indicates that, average returns realized on the sale of NTFPs is extremely low as the amounts reduces to almost nothing if spread across the entire 12 months period.

The study further established that the average annual income received by residents was about GH₵ 1759.48 with average financial returns from traded NTFP sales also about GH₵ 18.72. It therefore means that, the percentage of traded NTFPs to contribution to average household income is only about 1.1%. The amount of cash made from NTFPs sales is very low and contributes very minimal to the household income. That notwithstanding many residents noted that despite the situation, the small cash released is still able to cushion the household on a daily basis and also noted that there are still huge opportunities for the future sale of NTFPs as demand for NTFPs such as dawadawa and shea nuts is increasing.

A dawadawa trader in the market stated that,

"From these sales I make on this dawadawa spices and leaves, I am able to raise some cash to support the family. I usually will buy some food stuffs after sales to the house. But if am unable to realize any cash, I go back home, hoping my husband will bring in some money. This is not the situation all the time, sometimes I also buy on food stuffs on credit just to feed the home."

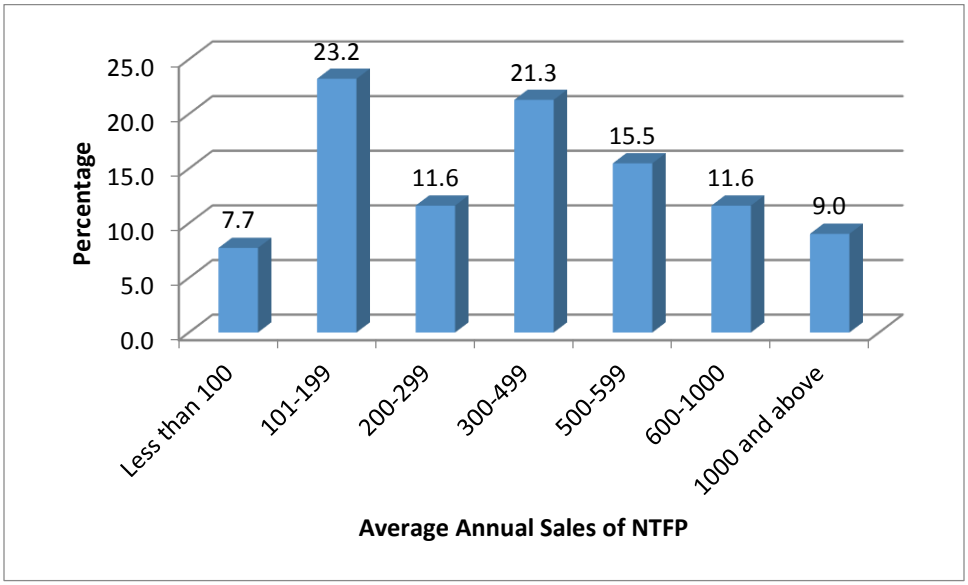


Figure 4.12: Financial Returns from NTFP Sale

Source: Field Data, 2017

The view that the amount received on the sale of NTFPs is low was however confirmed by residents. The Figure 4.13 show an overwhelming majority of the population indicated that the amount received from the sale of NTFPs and their annual household income received is not enough to take care of their household needs. A female respondent during focus group discussion at Oribili stated that the amounts payed for various forms of NTFPs were extremely low and that accounts for the low returns they make

"for the shea nuts/fruits (taame), we collect them from April to May and the current price for a bowl is GH₵4.50; dawadawa (dooro) and suge are also mostly harvested from March to April and the current prince of a bowl is GH₵9.00; yellow berry (ore) is harvested from April to May and the current price for a bowl is GH₵1.00"

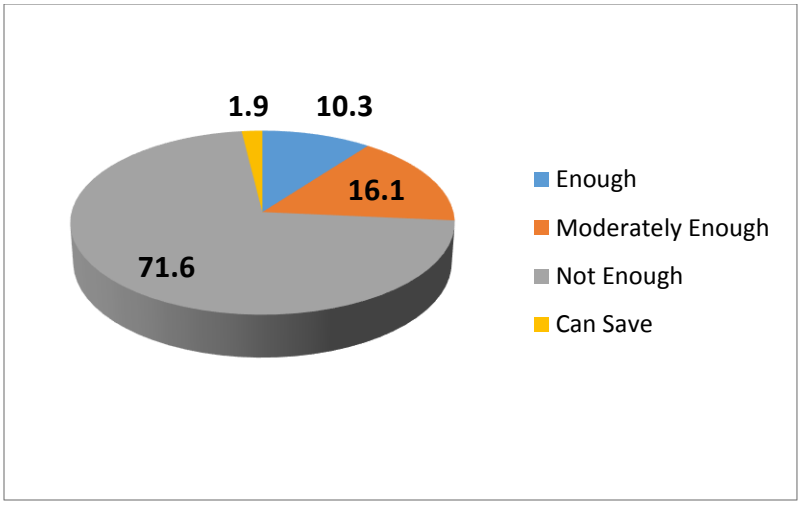


Figure 4.13: Perceptions on Cash Returns from Sale of NTFPs

Source: Field Data, 2017

Other respondents also noted that the cash return on the sale of NTFP is moderately enough (16.1%) and 10.3 percent indicating that the cash is enough. However, very small number of respondents making up only 1.9 percent of respondents noted that the cash is enough and they are able to make some savings.

This finding again reveals the perception of residents on the financial valuation of NTFPs in the Lawra District. Majority of residents still believe that in the future NTFP can become a more earner if only there are clear strategies to market the product, discover new uses and increase

demands beyond the District to other regions. A female dawadawa trader during informal conversations made the point that

> *"the dawadawa I sell here, the cost used to be nothing, 2 years ago, we sold a bowl around 3 cedis. As I speak to you a bowl cost 9 cedis. I believe this is as a result of its marketing that has increased its demand. Demand for it goes beyond the local demand, its bought by people and sent to Accra, Kumasi for sale in the major markets as well. That is contributing to the change in price at the local market here".*

4.10 Valuation of Non-Traded NTFPs

This study assessed the value of Non-traded NTFPs to residents in the Lawra District was assessed. The majority of the NTFPs listed, collected and used was not traded for cash returns. The NTFPs were directly used in most homes for consumption and to supplement the needs of the home. Figure 4.14 shows that households engaged in NTFPs collection do so for different intended benefits. Majority of collectors (34.8%) are for the medicinal values. From the earlier analysis in table 4.9, it confirms that almost all forms of plants and some animal's parts are used for their medicinal values. Again, 32.9 percent of respondents use non-traded NTFPs as food supplement at homes. This was again confirmed in table 4.9 on the uses and parts used of NTFPs which showed that all NTFPs including plants and animals were basically consumed as food at the household level. Further 18.7 percent, 12.3 percent and 1.3 percent represents NTFPs use for nutrition, employment and energy respectively.

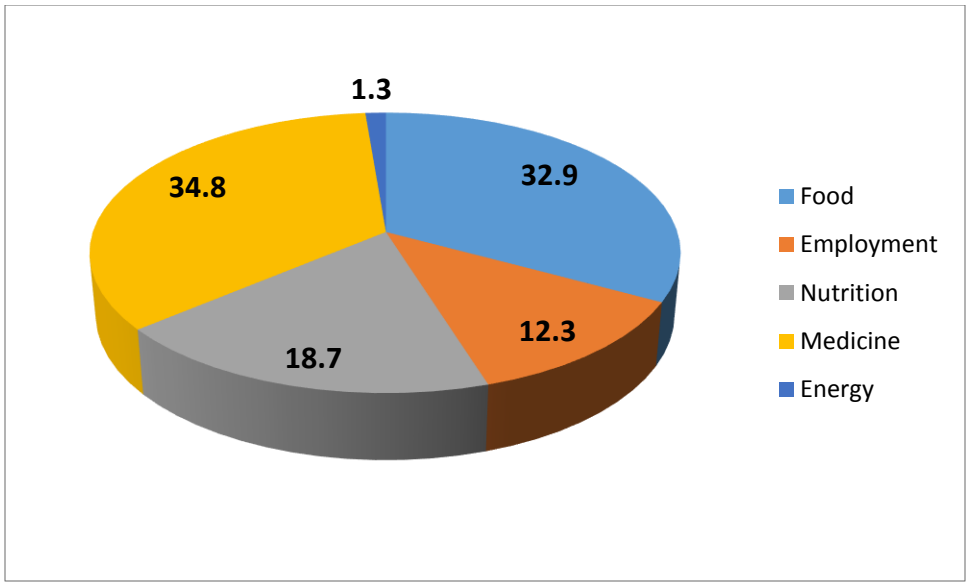


Figure 4.14: Non-Traded Benefits of NTFPs

Source: Field Data, 2017

At the community level, there are no great variations in the use of non-traded NTFPs. The medicinal and food benefits continue to dominate at communities. In Tolibri for example, majority of respondents (41%) use non-traded NTFPs mainly for medicines and 38.5 percent for food. A total of 17.9 percent of respondents in Tolibri also noted that non-traded NTFPs serve nutritional values. Similarly, in Berwong, 43.6 percent and 30.8 percent of respondents noted medicinal and food respectively as benefits. In Kanpouh however, most residents indicated that food (29.7%) and nutrition (29.7%) were the major benefits from non-traded NTFPs, followed by medicine (27%). In Oribili community, residents stated that the benefits of non-traded NTFPs included food (32%), medicine (27.5%), employment (20%) and nutrition (17.5%).

Table 4.12: Cross Tabulation: Community * Benefits of Non-Traded NTFPs

	Food	Employment	Nutrition	Medicine	Energy
Tolibri	38.5	2.6	17.9	41	0
Berwong	30.8	12.8	10.3	43.6	2.6
Kanpouh	29.7	13.5	29.7	27	-
Oribili	32.5	20	17.5	27.5	2.5

A correlation test was conducted to explain the variations observed in the responses among communities on the benefits of non-traded NTFPs. A negative weak correlation was observed with r approaching zero (0) (r = -0.05). The test further shows that the relationship is not a significant one at 0.501. That implies, the benefits of non-traded NTFPs do not vary much among communities, so residents' community does not influence in anyway the benefits derived from non-traded NTFPs. This results further relates with the views of the chief of Oribili who posited that,

> *"Majority of NTFPs used are not sold at all, we consume them mostly. The known ones that are sold are the same in our area and other villages. It is the same thing with the non-traded ones; we all have the same uses for them whether here or in the villages close to the White Volta, it is same uses"*

Table 4.13: Correlation Test: Community * Benefits of Non-traded NTFPs

Correlations		Community	Non-traded Benefits
Community Name	Pearson Correlation	1	-.054
	Sig. (-2tailed)		.501
	N	155	155
Non Traded Benefits	Pearson Correlation	-.054	1
	Sig. (2-tailed)	.501	
	N	155	155

Source: Field Data, 2017

4.11 Management Strategies and Challenges of Managing the Use of NTFPS

4.11.1 Local Authorities Involved in the Management of NTFPs

Management of NTFPs and any other resource is always vested in the hands of an authority that leads and ensures that the strategies put across to manage resources are adhered to. The study at the first instance sought to find out the role of various local authorities in the management of NTFPs in the Lawra District. The management of NTFPs is seen as a collective fight between state and private institutions as well as the communities themselves. It is important however to note that for management of local forests, the traditional leaders are usually seen at the forefront especially in areas that have lost direct touch with the everyday monitoring and work by the Assembly. The role of the local authorities in the management and conservation of NTFPs at the community levels were therefore examined.

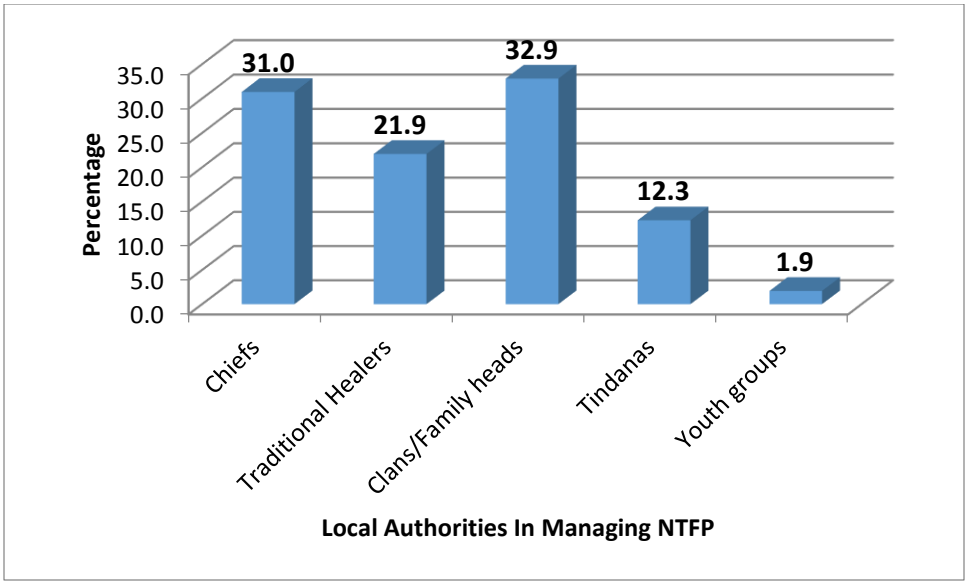


Figure 4.15: Local Authorities Managing NTFPs

Source: Field Data, 2017

The management of NTFPs is seen as a collective responsibility. Family/Clan heads (32%) are seen as the leading authorities in the management of NTFPs, closely followed by the chiefs (31%) who usually are responsible for resolving all boundary issues related to NTFPs among Clans and Families. Others including traditional healers, Tindanas and youth groups at a lower level are perceived as authorities managing NTFPs (see table 4.15). That notwithstanding, across all communities, it was noted that all the traditional leaders together play key role in defining strategies in managing NTFPs in the District. The various formal institutions including the District Assembly and NGOs, also confirmed the role of communities and their local authorities in managing NTFPs. According to a millet farmer in Kanpouh during key informant interviews:

"the management of NTFPs have been decentralized and left in the hands of various community leaders who together ensure that, there are strict regulations determined

communally and punishments are meted out to offenders"

4.12 Local Strategies in Managing NTFPs

Various strategies have been adopted at the local level to ensure the protection and conservation of the ecosystem as well as efficiently harvesting NTFPs in a sustainable manner. The study made efforts to understand the management strategies adopted at the community level as the first users of all NTFPs. Residents were therefore asked to state the effectiveness of various strategies used to enforce the management of NTFPs. The strategies included, adherence to government policies, use of District Assembly by-laws, use of community by-laws, rely on community volunteer groups and moral sanctions.

4.12.1 Adherence to Government Policies

According to Figure 4.16, majority of respondents noted that adherence to government policies across the various communities was effective (32.9%). Also, 27.7 percent of residents were of the view that the adherence to government policies in the management of NTFPs in the Lawra District was moderately effective. Further, only 14.2 percent noted that they adhere to government policies. However, 22.6 percent and 2.6 percent of respondents thought that the adherence to government policies in their various communities was rather ineffective and not applicable respectively. It is however clear that majority of residents across all communities agree that government policies play a role in the managing NTFP at the local level.

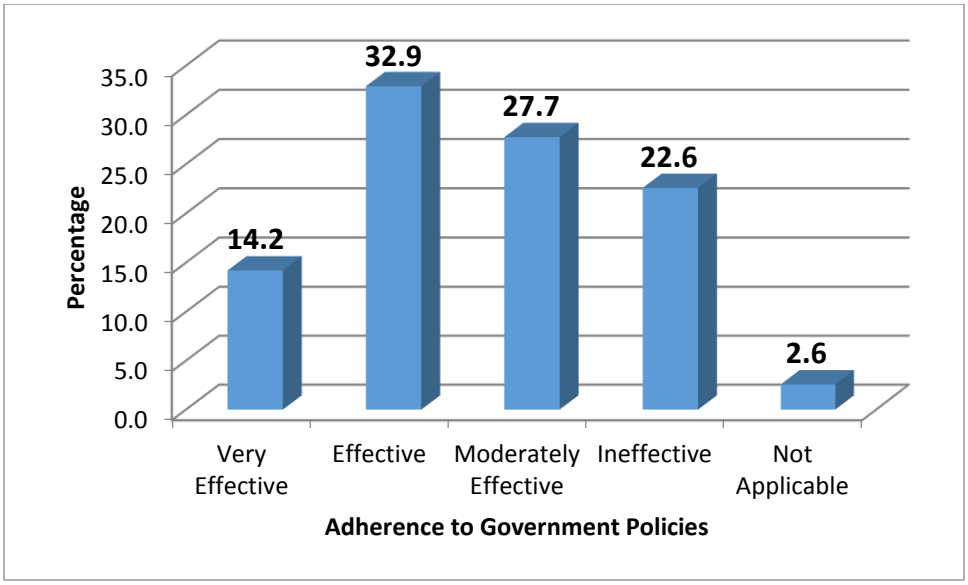


Figure 4.16: Adherence to Government Policies

Source: Field Data, 2017

The study also sought to assess the variations in community perceptions on the effectiveness of adherence to government policies in the management of NTFPs. A cross tabulation and chi square test of independence was performed to understand the community variations in adherence to government policies and the relationship between community of residence and adherence to government policies in managing NTFPs. Kanpouh community considered government polices to be moderately effective (45.9%) and effective (43.2%). Also, in Oribiri 30% of respondents indicated those government policies were very effective compared to other communities like Tolibri and Berwong where 30.8% of respondents noted government policies to be ineffective. (See table 4.13) A chi-square test conducted revealed that the relationship between community of residence and the effectiveness of government policies in managing NTFPs was significant at a chi square value of 36.432 at 12 degree of freedom and P-value of 0.000 less than the test significant level of 0.05.

Table 4.14 Cross Tabulations – Community * Adherence to Government Policies

Community	Very Effective	Effective	Moderately Effective	Ineffective	Not Applicable
Tolibri	10.3%	41%	17.9%	30.8%	0.0%
Berwong	10.3%	35.9%	20.5%	30.8%	2.6%
Kanpouh	5.4%	43.2%	45.9%	5.4%	0.0%
Oribiri	30%	12.5%	27.5%	22.5%	7.5%

X^2= 36.423 df = 12 P-Value = 0.000

Source: Field Data, 2017

4.12.2 District Assembly By-Laws

The Figure 4.17 reveals that majority of residents in all four communities are of the view that the District Assembly by-law is moderately effective (39.4%) in the management of NTFPs in the respective communities. Also, a significant number of residents making up 36.1 percent also noted that the District Assembly by-laws were effective in managing NTFPs.

At the community level, there were extreme variations in the responses of residents across all communities. Majority of respondents in Kanpouh and Berwong making up 51 percent and 56 percent of respondents in the communities indicated that District Assembly by-laws were moderately effective in the management of NTFPs. In Tolibri however, 43.6 percent of respondents indicated that the District Assembly by-laws were effective as compared to Oribili where the views of respondents were varied.

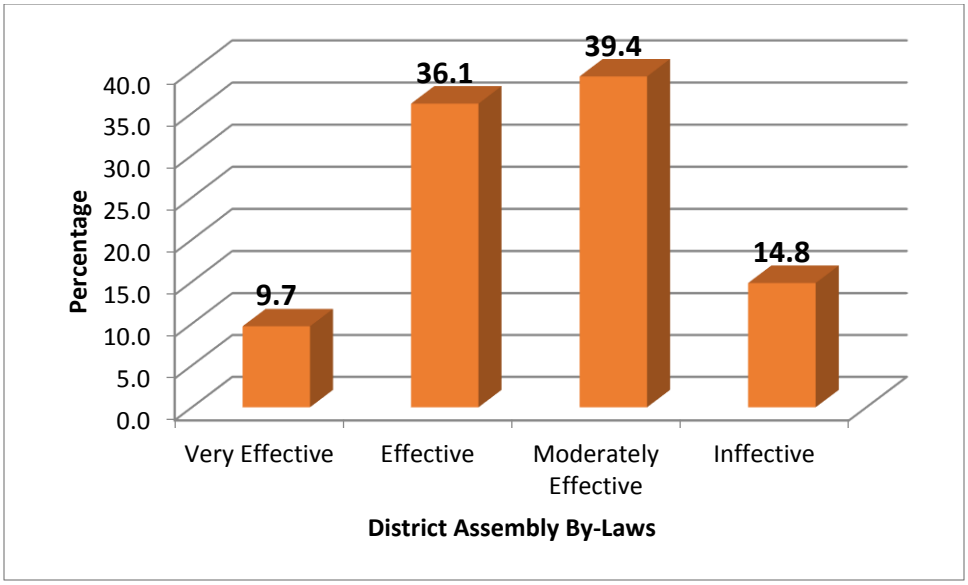


Figure: 4.17: District Assembly By-Laws

Source: Field Data, 2017

Table 4.15: Cross Tabulation: Community * District Assembly By-Law

Community	Very Effective	Effective	Moderately Effective	Ineffective
Tolibri	7.7%	43.6%	23.1%	25.6%
Berwong	7.7%	28.2%	51.3%	12.8%
Kanpouh	2.7%	40.5%	56.8%	0.0%
Oribili	20%	32.5%	27.5%	20.0%

X^2= 25.899 df = 9 P-Value = 0.002

Source: Field Data, 2017

4.12.3 Community By-Laws

Community by-laws constitute an important management strategy used in the Lawra District. According to the survey communities enact their by-laws; a number of communities were selected for direct inputs in preparing by-laws to conserve the environment as well as protect and manage NTFPs. The participatory approach adopted has seen community members themselves define all activities including bush burning, cutting of fruit trees, firewood production, and sale of wild fruits in market among others and also determined appropriate penalties for offenders.

The Figure 4.18 however reveals that majority of residents across all four communities were of the view that the use of community by-laws in managing NTFPs has been effective (63.9%) and also another 20 percent noting the by-laws to be very effective.

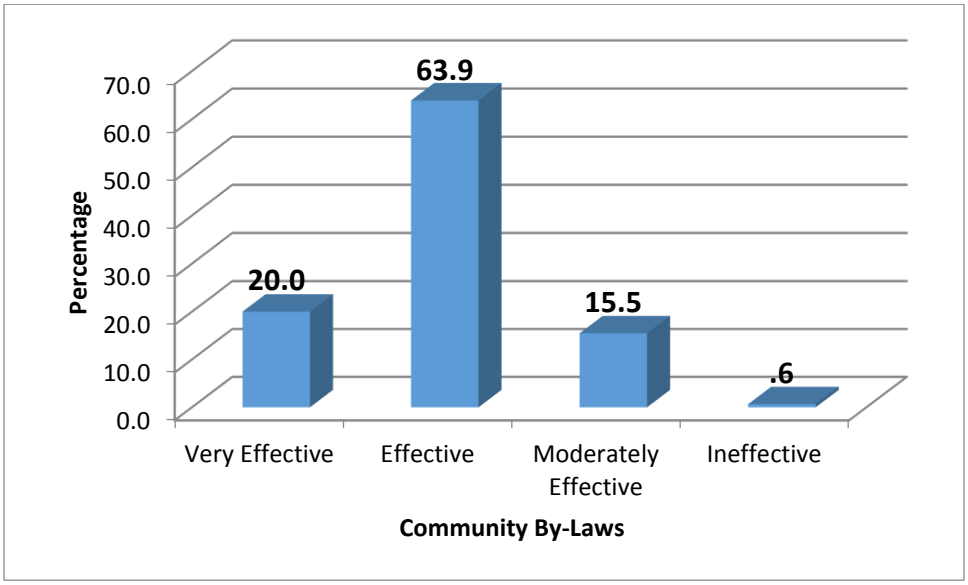


Figure 4.18: Community By-Law

Source: Field Data, 2017

At the community level, there are no observed extreme variations in the responses as all communities expressed some level of effectiveness of community by-laws in managing NTFPs in their communities. In Tolibri majority of respondents noted that the community by-laws were effective in managing NTFPs. In Berwong, 53.8 percent and 23.1 percent noted that community by-laws are effective and very effective respectively. The situation in Kanpouh is slightly different with a significant majority (83.8%) emphatically stating that the use of by-laws were effective in managing NTFPs. In Oribili, residents were almost leveled in their responses with 45 percent and 40 percent noting that community by-laws were effective and very effective respectively in their conserving and managing NTFPs.

The chi-square test of independence reveals a significant relationship between ones residential community and the use of community by-laws in managing NTFPs.

Table 4.16: Cross Tabulation: Community * Community By-Law

Community	Very Effective	Effective	Moderately Effective	Ineffective
Tolibri	15.4%	74.4%	10.3%	0.0%
Berwong	23.1%	53.8%	20.5%	2.6%
Kanpouh	0.0%	83.8%	16.2%	0.0%
Oribili	40%	45%	15%	0.0%

X^2= 26.131 df = 9 P-Value = 0.002

Source: Field Data, 2017

Further, interviews conducted with various institutions revealed that, at the community level, the participatory methods used in the preparation of the community by-laws contributed to its effectiveness as a managing tool. According to a coordinator of Tisong-taa Foundation (NGO) he noted that communities and traditional institutions form part of the management team of the various communities and District. The community members make up the major conservation groups including, community fire volunteer squad, afforestation committee and soil fertility improvement committee. Also, the Coordinator of Tisong-taa noted that,

> *"All trained communities have their own community environmental by-laws which have circulated to the traditional authorities in neighboring communities, the police, the GNFS, etc. for implementation and these by-laws spell out specific charges either in cash or in kind depending on the offence".*

Quite similar to his view is that expressed by HR Manager of the Forest Service Division of FC who also stated that,

> *"The communities and their traditional institutions are part of forest management processes in the District, through the formation of five volunteer squads; Community Forest Management Committees (CFMC); and formation of forest management clubs in basic and secondary schools to train students to educate their parents about environmental best practices".*

The case of Oribili is however unique in the sense that, they are not part of the communities selected for the pilot management program activities in the District unlike the other three communities. The community has historically used undocumented traditional regulations to protect their forests and NTFPs. According to oral information gathered, there are strong

traditional laws, taboos and strategies applied by individuals and society to ensure the conservation of NTFPs. A young man indicated that,

> *"In our community, trees such as Kazuge, Nieea and Gaa are used as traps to protect farmlands and NTFPs. The Kazuge and Nieea are mostly used during harvesting periods. The Nieea for example is like a 'rain god' or 'thunder' which will strike intruders on our farmlands or NTFP parklands. This has worked in this village and no one from our village will see this on any farm and still venture to enter"*

Again SEKAF Ghana limited (a local processing Industry) has supported the village in the protection of shea parklands. This is done to ensure that these areas remain green all year round and to protect such parks from overharvesting and indiscriminate destruction from community members. This was noted by community to account for the increase availability of NTFPs especially shea trees in the community.

4.12.4 Rely on Community Volunteers

Many residents in all study communities also noted the role of community volunteers. These are people that mostly contribute their time and resources to ensure people do not damage to the environment and consequently ensuring sustainable management of NTFPs. It is clear that there are members from communities that together formed groups with specific activities including firefighting; forest protection; tree cutting among other unacceptable practices that is likely to degrade the environment and affect the availability of forest resources especially.

The figure 4.19 show that only a few respondents making up 1.9 percent of total respondents noted that relying on community volunteers to manage NTFPs was inefficient. All remaining

respondents constituting 58.1 percent, 24.5 percent and 15.5 percent noted that such strategy to manage NTFPs is effective, moderately effective and very effective respectively.

The chi-square test and cross tabulations on communities and their perceptions on the effectiveness of relying on community volunteers also revealed that, there were statistical variations in the degree of effectiveness. In Tolibri, majority of the respondents (76.9%) noted that the reliance on community volunteers for the management of NTFPs is effective.

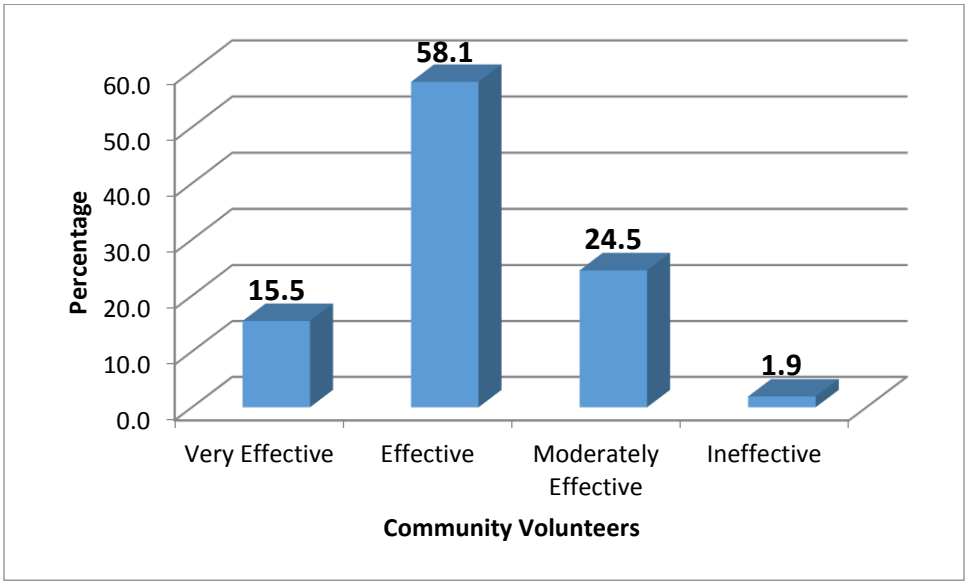


Figure 4.19: Rely on Community Volunteers

Source: Field Data, 2017

In Berwong, 43.6 percent and 38.5% of respondent noted that the strategy was moderately effective and effective and 15.4% indicating that the practice was very effective in managing NTFPs in the community.

Table 4.17: Cross Tabulation: Community * Rely on Community Volunteers

Community	Very Effective	Effective	Moderately Effective	Ineffective
Tolibri	12.8%	76.9%	10.3%	0.0%
Berwong	15.4%	38.5%	43.6%	0.6%
Kanpouh	8.1%	59.5%	29.7%	2.7%
Oribili	25%	57.5%	15%	2.5%

X^2= 20.725 df = 9 P-Value = 0.014

Source: Field Data, 2017

The situation in Kanpouh and Oribili is quite similar as residents making up 59.5 percent and 57 percent indicated that the strategy is an effective one. Also, 29.7 percent and 25 percent of respondents in Kanpouh and Oribili saw reliance on community volunteers as moderately effective and very effective respectively. The chi-square result also shows that the relationship between community and Reliance on community volunteers is significant.

4.12.5 Moral Sanctions

The study further assessed the perception of respondents on the effectiveness of moral sanctions in the regulation and management of NTFPs across study communities. Moral sanctions in the study communities were determined by the local authorities and meted out on offenders. From figure 4.20 majority of respondents expressed that moral sanctions is effective (58.7%).

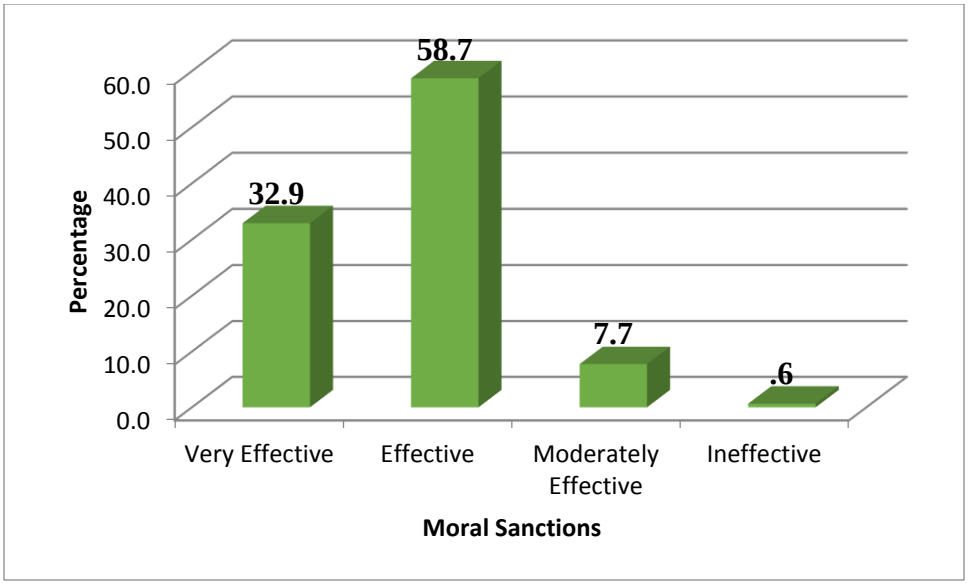


Figure 4.20: Moral Sanctions

Source: Field Data, 2017

Also from table 4.21, a total of 32.9 percent of respondents noted that such practice aids in the management of NTFPs.

Table 4.18: Cross Tabulation: Community * Moral Sanctions

Community	Very Effective	Effective	Moderately Effective	Ineffective
Tolibri	25.6%	66.7%	7.7%	00%
Berwong	28.2%	59%	10.3%	2.6%
Kanpouh	18.9%	73%	8.1%	0.0%
Oribili	57.5%	37.5%	5%	0.0%

X^2= 18.897 df = 9 P-Value = 0.026

Source: Field Data, 2017

At the community level, most of the respondents indicated that moral sanctions is effective in managing NTFPs in their respective communities except for Oribili where respondents noted that moral sanction is rather very effective (57.5%) in managing NTFPs. The chi-square test of independence however revealed that at a chi-square value of 18.897 at 9 degree of freedom and a P-value of 0.026 (less than 0.05 test significant level), there is a significant relationship between the community of residence and the perception on the effectiveness of moral sanctions in managing NTFPs (see table 4.18)

4.13 Role of Individuals in the Management of NTFPs

This study also sought to establish the role local residents play in the conservation of the environment, natural resources and sustainably using NTFPs. The role of locals is as key as that of all formal and local authorities as they remain the first in contact with the environment. This is also necessary as locals resort to NTFPs as a climate adaptation strategy to support their livelihood and again doubling up as conservationist. To assess the role of local residents in managing NTFPs, respondents were asked to indicate their activeness in specific management strategies including pouring libation to pacify gods when a sacrilege is committed, protection of sacred grooves, soothsaying to unearth impending disaster, assist chief and elders in resolving natural resource conflicts and to facilitate the formulation and enforcement of community by-laws on natural resource.

4.13.1 Pouring Libation to Pacify gods

In an attempt to understand the role of local residents in the pouring of libation to pacify gods, majority of respondents noted that such practice was not applicable to them. From Table 5.6, all

respondents across all study communities including Tolibri (87.2%), Berwong (82.1%), Kanpouh (73%) and Oribili (82.5%) emphatically noted that they play no such role. Such activities are regarded as reserved across all communities to very few families and elders who are entrusted with such roles.

Table 4.19: Cross Tabulation: Community * Pouring Libation to Pacify gods

Community	Very Active	Active	Dormant	Not applicable
Tolibri	0	10.3%	2.6%	87.2%
Berwong	2.6%	2.6%	12.8%	82.1%
Kanpouh	2.7%	21.6%	2.7%	73%
Oribili	0	12.5%	5%	82.5%

Source: Field Data, 2017

The study however sought to find out if the religious background of respondents influenced their decision to associate with such role viewed differently by varying religious beliefs. Table 4.19 show 95 percent of Christians indicated they play no role in the pouring of libation to pacify gods during periods when a sacrilege is committed. Similarly, all residents who follow the Islamic religion also stated no role at all with such practice. However, 33.3 percent and 4.2 percent of traditionalists noted that they were active and very active respectively in such activities. A chi-square test of independence was conducted to ascertain the relation between the two variables. The test reveals that, a chi-square value of 46.568 at a 6 degree of freedom and a P-value of 0.000 (less than test significant level of 0.005) there is a significant relationship between religious affiliation of residents and the role of pouring libation to pacify gods when a sacrilege is committed.

Table 4.20: Cross Tabulation: Religion * Pouring of Libation to Pacify gods

Religion	Very Active	Active	Dormant	Not applicable
Christian	0	2%	3%	95%
Islam	0	0	0	100%
Traditionalist	4.2%	33.3%	12.5%	50%

$X^2 = 46.568$ df = 6 P-value = 0.000

4.13.2 Protection of Sacred Grooves

Sacred grooves are usually reserved forests in communities that have significant religious connotations and are therefore protected from any form of especially human destruction. The study therefore sought to assess the role of residents in the protection of such sacred grooves in the study communities.

Table 4.21: Cross Tabulation: Community * Protection of Grooves

Community	Very Active	Active	Dormant	Not Applicable
Tolibri	0	20.5%	15.4%	64.1%
Berwong	0	12.8%	28.2%	59%
Kanpouh	0	29.7%	13.5%	56.8%
Oribili	2.5%	40%	10%	47.7%

Source: Field Data, 2017

Majority of residents indicated that they do not play any role in the protection of sacred grooves. In Tolibri, 20.5 percent of local residents indicated they play active roles in the protection of sacred grooves. Similarly, 29 percent and 40 percent of local residents in Kanpouh and Oribili communities respectively (see Table 4.12).

Protection of groves is also linked with religious connotations and so resident's choice to play a role in its protection is likely to be influenced by their religious affiliations. A cross tabulation of religion and protection of sacred grooves was conducted together with a chi-square test of independence to ascertain the significance of the relationship. From table 5.9, majority of Christians (63%) played no role at all in the protection of sacred grooves.

Table 4.22: Cross Tabulation: Religion * Protection of Sacred Grooves

Community	Very Active	Active	Dormant	Not Applicable
Christian	0	16.8%	19.8%	63.4%
Islamic	0	0	16.7%	83.3%
Traditionalist	2.1%	47.9%	10.4%	39.6%

$X^2 = 21.748$ df = 6 P-value = 0.000

Source: Field Data, 2017

A few Christians making up 16.8 percent were active performing various roles in the protection of sacred grooves. For those practicing Islam, 83.3 percent and 16.7 percent indicated that the protection of sacred grooves was not applicable to them or they were dormant. On the other hand, traditionalists (47.9%) played active roles in the protection of sacred grooves. However,

39.6 percent of them also noted that it was not applicable to them. The chi square test reveals that with a value of 21.748 at 6 degree of freedom and a P-value of 0.001the relationship between religion and the protection of sacred grooves is significant.

4.13.3 Soothsaying to Unearth Impending Disaster

The act of soothsaying has strong spiritual and religious linkage usually involving some forms of incantations, divinations to foretell the future or prognostication. Such are seen as part of the traditional fabrics of society. In this study, the role of the resident in soothsaying to unearth impending danger on the society is assessed. From Table 4.23, an overwhelming majority of residents within each community noted that such role was not applicable in their cases. In Tolibri, as many as 84.6 percent of respondents say they do not play any role as soothsayers. Similarly, in the other communities including Berwong, Kanpouh and Oribili had 74.4 percent 67.6 percent and 75 percent respectively.

Table 4.23: Cross Tabulation: Community * Soothsaying

Community	Very Active	Active	Dormant	Not Applicable
Tolibri	0	12.8%	2.6%	84.6%
Berwong	0	10.3%	15.4%	74.4%
Kanpouh	8.1%	10.8%	13.5%	67.6%
Oribili	2.5%	10%	12.5%	75%

Source: Field Data, 2017

However, about 12 percent in Tolibri and 10 percent each in all other three communities also

noted that they were active in soothsaying activities. In Kanpouh however, 8 percent of the residents stated that they are very active in soothsaying to unearth impending disasters on their community.

The study further made efforts to establish the relation between soothsaying and religious background as such activity as stated has strong links with religious affiliations of individuals. According to table 4.24, Christians making up 89.1 percent were of the view that they do not play any role at all when it comes to soothsaying. Again, all Islamic residents constituting 100% of them also stated that such soothsaying practice was not applicable to them. With the traditionalist on the other hand, 29.2 percent and 6.2 percent of them indicated they play active roles and very active roles respectively in soothsaying. Such practice however has strong linkages with the traditionalists than the other religious denominations.

Table 4.24: Cross Tabulation: Religion * Soothsaying to Unearth Impending Disaster

Community	Very Active	Active	Dormant	Not Applicable
Christian	1%	3%	6.9%	89.1%
Islamic	0	0	0	100%
Traditionalist	6.2%	29.2%	20.8%	43.8%

$X^2 = 40.476$ df = 6 P-value = 0.000

Source: Field Data, 2017

The chi-square test of independence sought to establish if the relationship between religion and soothsaying was significant. At a chi-square value of 40.476 at 6 degree of freedom, the P-value is 0.000 which is less than the test significant level of 0.005. Also, the chi-square result, there is a

significant relationship between religion and soothsaying to unearth impending disasters (see table 5.11)

4.13.4 Assist Chief and Elders in Resolving Natural Resource Conflicts

Many local level conflicts have been caused by limited access to natural resources or excessive power play among local people. Several sanctions and ways of finding amicable solutions are used by local authorities to resolve such conflicts. Again, participation of local people in the resolution of natural resource conflicts has the tendency to increase their commitment to protecting these resources. The table 4.25 shows that across all communities there is a participatory approach used in the resolution of resource conflicts with many residents playing roles in the process. In Tolibri, 51.3 percent of respondents play active roles in resource conflict resolutions. In all three other communities, respondents constituting 64.1percent, 64.9 percent and 37.5 percent were involved actively in assisting local authorities in the resolution of natural resource conflicts in Berwong, Kanpouh and Oribili respectively. Again, in Oribili, another 32.5 percent of residents noted they play very active roles in natural resource conflict resolution in the community. The increased number of participation by local residents in Oribili is due to the openness of the process which is not hijacked by few influential people which is likely the case in the other communities.

Table 4.25: Assist Chief and Elders in Resolving Natural Resource Conflicts

Community	Very Active	Active	Dormant	Not Applicable
Tolibri	5.1%	51.3%	12.8%	30.8%
Berwong	5.1%	64.1%	12.8%	17.9%
Kanpouh	2.7%	64.9%	8.1%	24.3%
Oribili	32.5%	37.5%	17.5%	12.5%

Source: Field Data, 2017

Nonetheless, the decision making process at the local has always been accused of biasness towards the male sex. There are increased calls for the participation of females in all decision making process from the local level to the national level and beyond. The study examined whether sex plays a significant relation to people's decision to assist the chief and elders in resolving natural resource conflicts.

Table 4.26 shows that, 18.5 percent and 68.5 percent of males play very active and active roles respectively in assisting elders and chiefs to resolve natural resource conflicts, while female were lower, with 7.9 percent and 46.5 percent assisting in natural resource conflict resolution. One-third of the female (31.7%) play no role at all. The chi-square test conducted showed that at a value of 21.455 at 3 degree of freedom and a P-value of 0.000, there is significant relationship between sex and assisting chiefs and elders in resolving natural resource conflicts.

Table 4.26 Cross Tabulation: Sex * Assist Chiefs and Elders in Resolving Natural Resource Conflicts

Sex	Very Active	Active	Dormant	Not Applicable
Male	18.5%	68.5%	11.1%	1.9%
Female	7.9%	46.5%	13.9%	31.7%

$X^2 = 21.455$ df = 3 P-value = 0.000

Source: Field Data, 2017

4.13.5 Facilitate the Formulation and Enforcement of Community By-Laws on Natural Resource

A common participatory strategy used in natural resource management is allowing community residents to partake in the drafting and formulation of community by-laws to protect their own resources. Such is deemed more successful as the local people define the law to protect their own environment and so will ensure its implementation to the latter. Across all study communities, residents participate in the formulation of community by laws. The number of participants in each community forms the majority and this is good for the governance of the local resources..

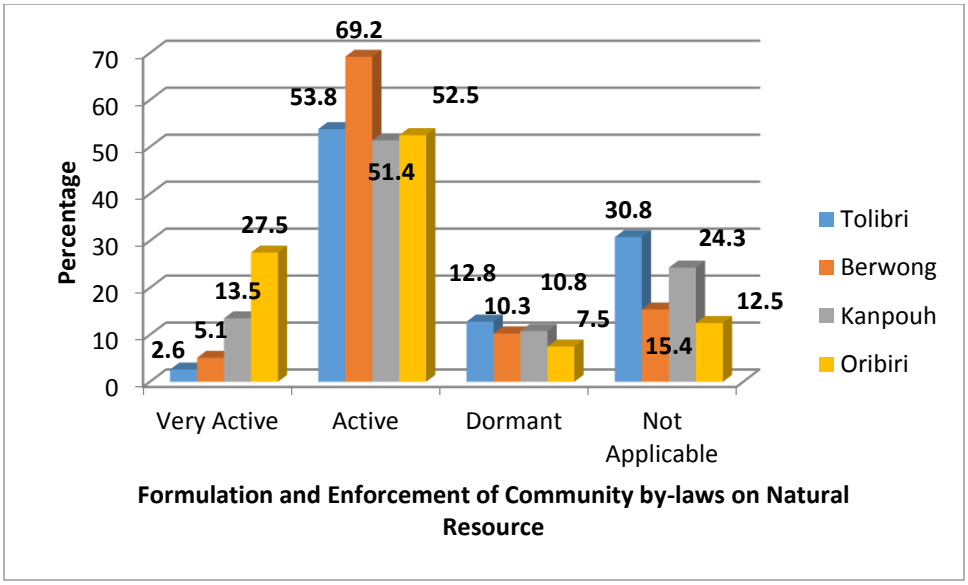


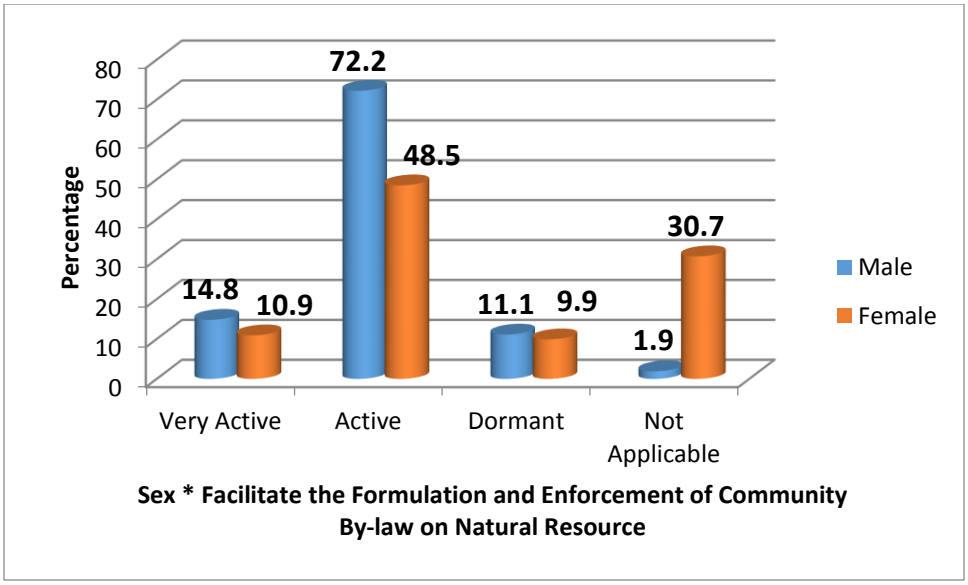
Figure 4.21: Facilitate the Formulation and Enforcement of Community By-Laws on Natural Resource

Source: Field Data

According to Figure 4.22 in Tolibri and Berwong, 53.8 percent and 69.2 percent of respondents were active in the formulation of community by-laws. Further 13.5 percent and 51.4 percent in Kanpouh and 27.5 percent and 52.5 percent in Oribili were both very actively and actively facilitated the formulation and enforcement of community by-laws on natural resources

Further, there were variations in the participation of both men and women in the facilitating the formulation and enforcement of community by-laws on natural resource. Figure 4.22 show 72.2 percent and 14.8 percent of males play active and very active roles in facilitating the formulation and enforcement of community by-laws on natural resource management whereas only 48.5 percent and 10.9 percent of female participated in such community activities. Such gave more room for men to participate than females. Only 1.9 percent of males indicated they played no

role compared to the 31.7 percent of females in the communities. The chi-square test of independence further reveals that there is a significant relationship between sex and facilitating the formulation and enforcement of community by-laws on natural resource. The chi-square value of 18.152 at 3 degree of freedom had a P-value of 0.000.



$X^2 = 18.152$ df = 3 P-value = 0.000

Figure 4.22: Cross Tabulation: Sex * Facilitate the Formulation and Enforcement of Community By-law on Natural Resource

Source: Field Data, 2017

4.13.6 Enforcement of Traditional Norms, Beliefs and Practices on Natural Resource Management

The enforcement of traditional norms and beliefs are in many cases left in the hands of local authorities. Through participatory approaches, residents are similarly obliged to ensure that such norms and beliefs protecting natural resources are enforced at all times. The study there sought to

assess the role of community members in the enforcement of traditional norms, beliefs and practices in protecting the natural resource base of the communities. The figure 4.23 shows that in all study communities, residents play an enforcement role in ensuring that traditional norms and beliefs were practiced to protect the natural resources. In Tolibri and Berwong, 56.4 percent and 61.5 percent of respondents noted they play active roles in this respect. In Kanpouh, 56.8 percent play active roles. In Oribili however 45 percent and 32.5 percent play very active and active roles respectively in enforcing traditional norms, beliefs and practices to protect natural resource management.

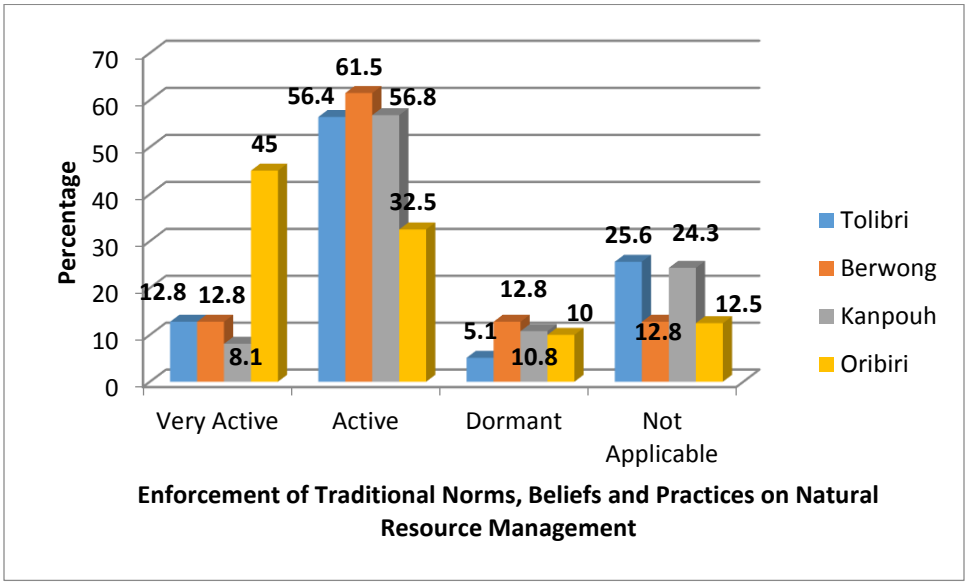


Figure 4.23: Enforcement of Traditional Norms, Beliefs and Practices

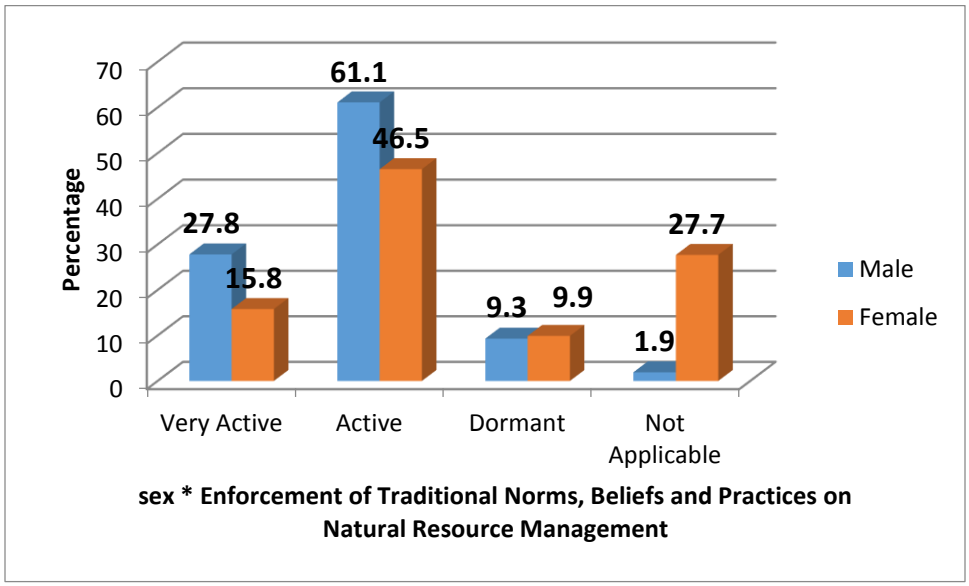
Source: Field Data, 2017

According to the best millet farmer in in Kanpouh,

> *"communities have adopted various strategies to manage NTFPs including no trespassing of neighboring communities, pruning of old trees for new shoots, using*

traditional traps, taboos in the management process as well as announcing bad practices with bell, whiles the culprit is charged as well as pay for all additional expenses in pursuing the case of the offender".

The cross tabulation conducted reveals that there are variations in the participation of male and female sexes in the enforcement of this role. A total of 27.8 percent and 61.1 percent of males indicated they play very active and active roles in the enforcement of traditional norms, beliefs and practices. On the other hand, 15.8 percent and 46.5 percent of females are very active and active in such roles respectively. Nonetheless, a significant 27.7 percent of females do not partake in such roles at all (See figure 4.24).



$X^2 = 16.558$ df = 3 P-value = 0.001

Figure 4.24: Enforcement of Traditional Norms, Beliefs and Practices

Source: Field Data, 2017

However, the chi-square test conducted further revealed that there is a significant relationship between sex and the enforcement of traditional norms, beliefs and practices on natural resource management. The chi-square value is 16.558 at 3 degree of freedom and a P-value of 0.00.

4.13.7 Punish Offenders of Natural Resources Related by By-Laws

Community members were again assessed on the roles in the punishment of offenders of natural resource related by-laws in their communities. The pronouncement of such punishments were the reserve of authorities nonetheless, community members are seen to play key roles in this regard. The study results in Figure 4.25 shows that community members play active roles in the punishment of offenders of natural resource related by-laws. Over 66 percent of respondents in Tolibri play active roles where as in Berwong, members play both very active (15.4%) and active (59%) roles. In Kanpouh locals indicated that they play very active roles (10.8%) and active roles (62.2%) respectively.

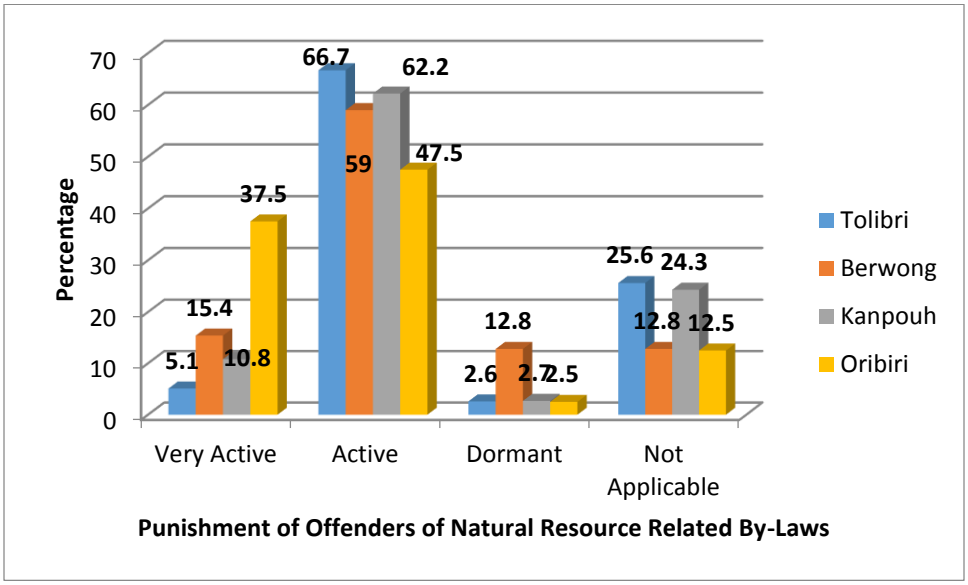
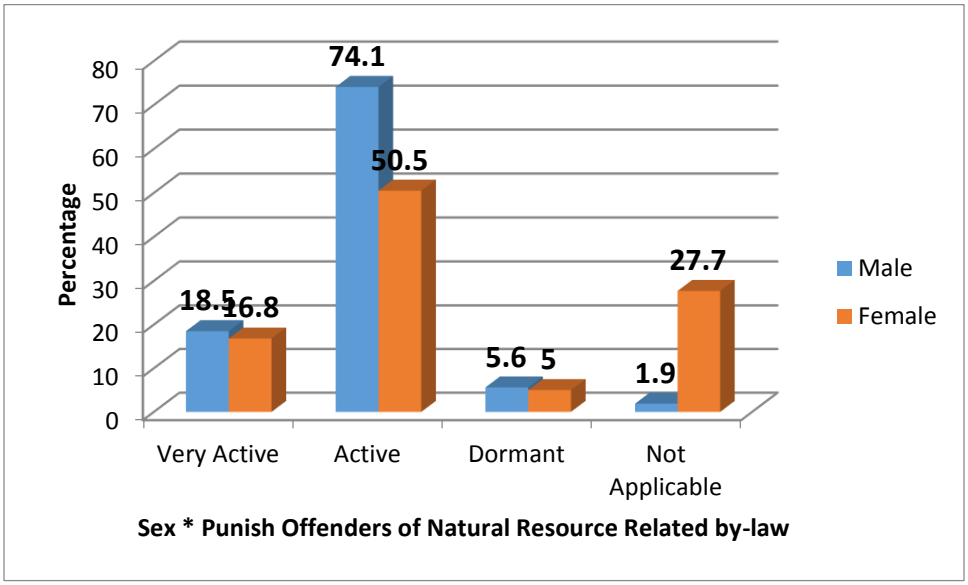


Figure 4.25: Punishment of Offenders of Natural Resource Related Laws

Source: Field Data, 2017

In Oribili however, a total of 37.7 percent of respondents play very active roles and 47.5 percent actively are engaged in the punishment of offenders of natural resources related laws.

The sex distribution similarly noted that more males were engage in this practice than females. A total of 18.5 percent and 74.1 percent of men play very active and active roles respectively. The female respondents on the other hand indicated that they 16.8 percent and 50.5 percent of play very active and active roles respectively. The chi-square test of independence however showed that at value of 16.002 at a 3 degree of freedom and a P-value of 0.001, there is a significant relationship between sex and punishment of offenders of natural resource related laws (see figure 4.26.



X^2 = 16.002 df = 3 P-value = 0.001

Figure 4.26: Cross Tabulation: Sex * Punish Offenders of Natural Resource Related Laws

Source: Field Data, 2017

4.14 Sources of Resources for the Management of NTFPs

Resources are needed to ensure that the various management practices in the local communities remain key in successfully implement all management practices. Figure 4.27 shows that the majority of residents noted that the major source of resources for the management of NTFPs is through community fines charged offenders (61.3%), while other sources included government organizations and NGOs (19.4%) and contributions from community members (19.4%).

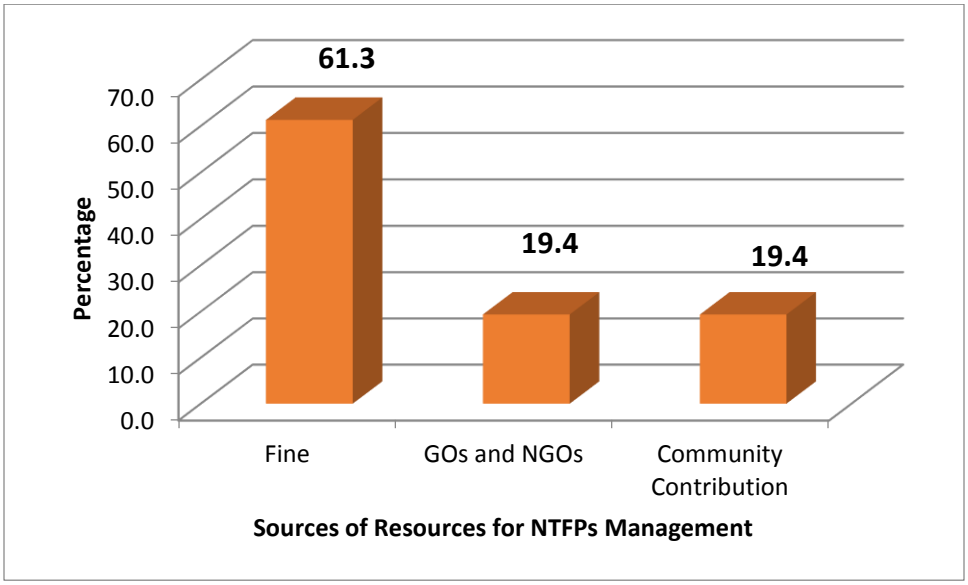


Figure 4.27: Sources of Resources for NTFPs Management

Source: Field Data, 2017

4.14.1 Community Fines

Community fines are seen as a major source of resource for the management of NTFPs in all communities. Such fines are defined by local community members in the process of formulating by-laws for the protection of conservation of environment as well us sustainably using NTFPs. According to documents from the local community on the Enactment of community by-laws and

regulations against bush fires and deforestation, they noted that various communities were involved in the formulation process. The resultant by-laws included all participating communities as well as the penalties or fines defined at two levels for every community. Penalties have been leveled for an offender who is a member of the community and also for an outsider. The Kanpouh community agreed that a fine of 40cedis will be imposed on an offender who is a community member whereas for an outsider, 100 Cedis for bush burning offence and tree cutting, 40 Cedis for hunting, 60 Cedis for sale of fruits as well as 100 Cedis for cutting grass. In Tolibri, an offender from the community pays a fine of 20 Cedis whereas for an outsider, a three year old ram, a cock and four fowl and additional 20 Cedis is taken as total penalty. In Berwong however, the penalties appears heavier than the other two, with an insider paying 200 Cedis and three fowls whereas an outsider pays 200 Cedis, a fowl and a sheep. The fines were determined by the community members themselves and have not been influenced by any single person or institutions.

The cash and penalties are used in restoring the environment as well as supporting NTFP management practices.

4.14.2 Funds from GOs and NGOs

The study also found out that a number of assistance and support is given to various communities on their role in ensuring the management of NTFPs as well as protecting the environment. The major government institution is the Lawra District Assembly through whom all forms of government supports are sent through. Various NGOs are also noted to be operating in the District with specific objectives and targets which defines their areas of support to the various communities. Tisong-taa Foundation is an NGO group interested in the management of bush

fires, environmental protection on communal lands as well as natural regeneration and tree management and protection. They engage communities through sensitization, education and training programs. According to the Co-coordinator of the Tisong-taa Foundation,

> *"land and water resource management projects that organizations execute and it involves managing bush fires, application of soil and water conservation practices on farms (ie ridging across sloping lands, stone lining on contours and gunging) and application of soil fertility improvement practices e.g. Compost making and application, crop rotation, legume/cereal intercropping which all leads to a 100% increase in crop yields"*

Another one is the Forest Service Division of the Forestry Commission which engages in the management of forests, NTFPs and wildlife resources. According to the Human Resource manager,

> *"we run sustainable program through education and sensitization, encourage people to plant more trees, train individuals to engage in environmentally sound livelihood activities such as bee keeping and livestock rearing among others. We have also made efforts at supporting climate change adaptations in the District with, District climate change platform that seek to educate communities and individuals on best practices. Other stuffs include the CIRS (SARI) platform to train farmers on new planting techniques, FSD for education on forest related issues such as bush fires, tree planting etc".*

According to the best millet farmer in Kanpouh, MoFA has also engaged communities in training them on erosion control using available materials such as boulders, terracing among

others.

> *"Planting of seeds on flatlands instead of raising mounds, producing organic manure from plant residues and household organic waste, farming equipment for plantings including a shea nut processing mill".*

4.15 Challenges Confronting Management and Use of NTFPs

The management of NTFPs and conservation of the ecosystem is necessary for the sustainability of local livelihoods. The management process, availability and use of NTFPs are however faced with numerous challenges that are grouped under 5 broad categories. Figure 4.29 show that respondents views on the challenges did not differ so much with challenges with by-laws (23.9%) indicating the highest factor and followed by harvesting and processing challenges (21.3%) and climate change (20.6%). Also, animal and plant invasion challenges constituted 18.7 percent with marketing relating challenges making up the remaining 15.5 percent.

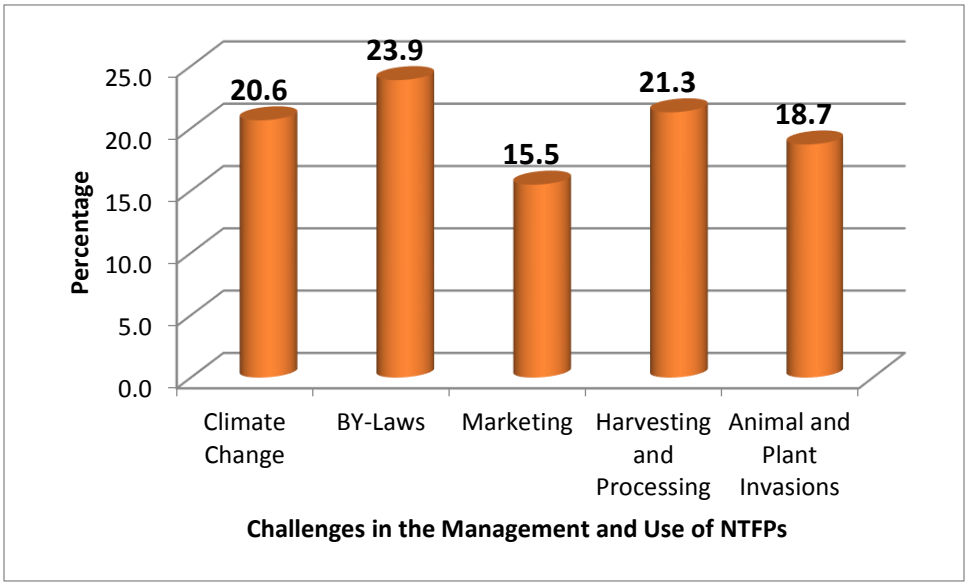


Figure 4.28: Challenges/Threats in the Management and Use of NTFPs
Source: Field Data, 2017

The study made efforts at examining the spatial variations in community perceptions on what constitutes the challenges faced in the management and use of NTFPs. From table 4.28 there are community level variations observed across the study community. In Tolibri, majority of respondents noted harvesting and processing challenges (33.3%), followed by animal and plant invasions (30.8%) as well as marketing (23.1%) as top challenges. In Berwong community, majority of the respondents noted challenges with the by-laws (38.5%), climate change (23.1%) and harvesting and processing as topmost challenges faced by the community. Similarly, respondents in Kanpouh also identified by-laws (29.7%), climate change (24.3%) and Marketing (16.2%) and harvesting and processing (16.2%) respectively. In Oribili however, climate change and by-laws were indicated as top most challenges making up 25 percent and 25 percent respectively. Also, harvesting and processing and animal (20%) and plant invasion (20%) are the other two challenges noted.

Table 4.27 Cross Tabulation: Community * Challenges of Management and Use of NTFPs

Communities	Climate Change	By-Laws	Marketing	Harvesting and Processing	Animal and Plant Invasions
Tolibri	10.3%	2.6%	23.1%	33.3%	30.8%
Berwong	23.1%	38.5%	12.8%	15.4%	10.3%
Kanpouh	24.3%	29.7%	16.2%	16.2%	13.5%
Oribili	25%	25%	10%	20%	20%

Source: Field Data, 2017

In the light of the varied community level responses the study conducted a chi-square test of independence to ascertain whether the challenges faced by respondents were dependent on the community of residence.

The test reveals a chi-square value of 25.495 at 12 degree of freedom and a P-value of 0.013. This indicates a significant relationship between the community of residences and challenges faced with the management and use of NTFPs. In other words, the challenges faced by residents in the management and use of NTFPs are dependent on the community of residence.

4.15.1 Climate Change Related challenges

Climate change related challenges were identified as a major challenge to the management and use of NTFPs in all communities and the District at large. Also, various activities such as reduced harvest due to shorter rainfall seasons and high temperatures, rain and wind storms and bush fires were notable climatic factors that affect the management and use of NTFPS. According to a farmer at Kanpouh,

> *"although we have seen an increase in the number of tree species, the yields are usually low due to erratic rainfall and heavy storms that destroy and disperse the trees and fruits".*

Also, during FGDs, a 45 years old male farmer stated that,

> *"as the rains become more erratic, the temperatures are increasing and the heat affects most the plants during the flowering period, thereby reducing their potential to bear fruit".*

In many cases, bush fires have also been cited as a climate related factor as during the dry season, most of the fires are caused by natural factors. The cause of bush fires are widely known to be either natural or anthropogenic. Even though most residents admit people do set fire, they noted the natural cause as the main factor. According to a female NTFP harvester, she replied that,

> *"the bush fires are just too much. Today you harvest fruits here, the next day you can have the whole area burnt including the trees. This is mostly in the dry season with high temperatures".*

Another female NTFP harvester during the FGD at Tolibri shared her experience with rain and wind storms, noting that,

> *"somewhere early this year, March into April, there was a heavy wind storm that pulled down most of the trees where I usually harvest fruits. We tried supporting some young plants back but the next night saw a heavier storm destroyed completely these plants. The climate change thing is getting harder and harder".*

4.15.2 By-Laws

Despite lauding the enactment of by-laws by communities, its implementation however faces a number of challenges. The by-laws currently do not cover all villages and communities as some of them are yet to come out with their own by-laws. This revealed by the Co-coordinator of the Tisong-taa Foundation who noted that,

> *"high percentage of the communities in the District are yet to come out with their by-laws. Even with those who have theirs ready, it must go through the District assembly for approval and adoption before they can be used. However, the Assembly is yet to adopt*

and pass these community by-laws to cover the entire District."

He further stated that the laws must be allowed to work and must left in the hands of the traditional leaders rather than paramount chiefs and others,

> *"the local traditional leaders need to be more empowered to handle the environmental issues at all village levels. This way the by-laws will become more efficient in tackling the many management and use challenges of NTFPs in the District"*

In the Oribili community, most farmers expressed similar views on the difficulties in implementing the by-laws to the later. They noted that, the coming into force of the by-law has brought some change but until they tighten the implementation, the effectiveness will be rather slower than thought.

> *"see, people are still cutting down trees indiscriminately and at will because the laws are not applied sometimes equally to all persons. Bush burning is still been done by some bad people for their own gains mostly for certain games. But this can only be stopped when you apply the by-law to all persons equally"*

The farmers view at Oribili was confirmed in a key informant interview with a farmer and youth leader in the same community, who stated that,

> *"The community cannot implement the by-laws effectively, because it has little right to the land. The paramount chief interferes and doesn't allow the community to enforce the by-laws especially on bare/fallow lands"*
>
> *"Restrictions placed on neighboring communities and colleague farmers from collecting NTFPs on their land sometimes results in resource conflicts and fights"*

4.15.3 Marketing Challenges

Poor pricing has been noted as the major challenge in the marketing of NTFPs, many of the farmers lamented. Sales are usually made from either selling to individuals or to middlemen. The pricing for individuals is considered lower by most people noting that the quantities sold by individuals are usually not enough and so despite the difficulties in the gathering and preparation of these fruits to the market, the cash returns do not make up for the stresses gone through.

During focus group discussions at Oribili, a 62 year old woman explained that,

> *"when you sell a bowl of shea nut, on a good day you will make about GH₵4.50 pesewas, dawadawa goes for about GH₵ 9.00 for a bowl. Yellow berry is bought at GH₵1.00 per bowl. The prices are not good at all if you are selling directly in the market. But it will be different for middlemen who buy from different places and have it in stock before selling; they are able to make good cash us who struggle under the sun"*

Again, some people were concerned about the market size, they believe that if some of these fruits and products are placed on the bigger markets for people to access, demand will increase and that increase the cost for the poor farmer to have some benefit. A farmer in Berwong also stated that

> *"the could be huge potentials for these NTFPs beyond our local areas here but because people don't know about them, the market base is small. See if you understand the nutritional values of some of these products like the shea nut, dawadawa and others you can tell people about it. Government and the NGOs too can take it up and market them during different programs, then we will commit much time and energy into managing and sustaining their availability"*

4.15.4 Harvesting and Processing of NTFPs

The harvesting and processing of NTFPs is noted to be laborious and demanding task involving various steps. It also varies with the type of product been harvested or animal hunted for. For most of the plant NTFPs, it is noted by many as a daunting task in its harvesting and processing usually done through unsustainable harvesting measures. During the FGDs, in Berwong, a 32 years old lady noted that,

> *"the methods we use in harvesting most of the NTFPs is so unsustainable. We sometimes break sticks and use for harvesting some fruits or using the hand to pluck fruits".*

Another female reported that,

> *"it is not easy harvesting at all, going through the harsh sunlight all day just in search of fruits on the trees affects us badly. But that is what we have to do since our farms are not helping us again. The processing of some these NTFPs also takes very long periods especially the processing of dawadawa and the shea nut"*

4.15.5 Animal and Plant Invasions

Certain plant and animal species are also noted for causing huge destruction to NTFPs. Some of the animals also feed on the NTFPs as food whereas others in the process end up destroying more than they actually need to feed on. It is a cause of worry even though this is noted to be a low level. Information gathered from the local people points to the fact various animals attack the NTFPs and destroy them. Some of the people during FGDs shared their experiences.

> *"In the bush, there are these monkey species called 'taaweal' that we note enjoy eating fresh dawadawa, so during growth periods, the more you abandon the farm, the likely it*

is that this monkeys will come and eat your fresh dawadawa" (48 years old farmer and hunter).

"*There are also different bird species that feeds on NTFPs in the bush. We have a local bird we usually called 'dakyea', they are noted to feed on different fruits and the flowers sweet nectar. They end up destroying the flowering and so reducing the potential fruit production of the plant"* (45 years Old NTFP harvester).

CHAPTER FIVE

DISCUSSION

5.1 Introduction

The Chapter presents the discussions of the results presented in chapter four within the context of the wider literature. The discussion dwells on the NTFPs as a climate change adaptation strategy, the valuation of NTFPS and its contribution to household livelihoods and the management of NTFPS and the challenges faced. The chapter provides insights into the findings of the study within existing literature to better understand the state of NTFPs globally, its contribution to household livelihoods and management strategies adopted to ensure the creation of a sustainable industry to support global fight against poverty especially among climate dependent agricultural communities.

5.2 NTFPs as a Climate Change Adaptation Strategy

Worldwide climatic variations have continued to change with its effects experienced differently across regions. According to USAID (2011), Ghana is among countries in Africa that is among the most vulnerable to climate change effects as a result of its large population still dependent on climate controlled agriculture. According to the GSDA (2010-13) (2007), various climate change vulnerability assessments on Ghana show that the country suffers from adverse effects of climate change as the economy is dependent on sectors predominantly dependent on climate. This has resulted in widespread poverty and vulnerability to climate stress. A USAID (2011) report on Ghana indicates that the climate of Ghana is warmer compared to previous years with the rate of increase about 1.0^0C affecting mostly the northern part of the country than the south. This supports the research findings that temperature continues to rise while rainfall declines of the

past years in the Lawra District. In the study area, residents' perceptions on climate change and climate data shows changing climate conditions that are affecting agricultural livelihoods in the Lawra District.

The changing climatic conditions have severe consequences on sustainable development and on various sectors of growth including agriculture, food security and forest ecosystems (IPCC, 2007). This affects more climate dependent community livelihoods that depend on farming. Similarly, Chia et al. (2013) posited that climate change extremes have devastating impacts on the poor. Several studies, including Gain et al., (2012) Huq et al. (2012), Karim et al. (2012) and Auerbach et al. (2015) show that climate change impacts has affected agricultural productions especially in Bangladesh where there is high dependence on agriculture for sustaining household livelihoods. Such climate dependent communities have low adaptive capacity due to endemic poverty, unplanned economic development among others increasing their susceptibility to climate and non-climate related shocks (Burton et al., 2004; Huq et al., 2005). In Tanzania, agriculture was singled out to be the most affected by climate change consequently affecting the livelihood of communities dependent on agriculture (Msalilwa, 2013). Clearly, the demographic characteristics of respondent's further show that the study communities have low adaptive capacity to address low crop outputs.

Notwithstanding the low capacity of communities to initiate measures to rejuvenate agricultural outputs, other forms of alternative livelihood are been adopted as coping strategies. Msalilwa (2013) identified various strategies used by local agricultural dependent communities to cope with climate change variability in Tanzania. NTFPs played the lead role as a climate change

adaptation strategy for forest dependent communities. Such NTFPs were used for subsistence and an income source providing a safety net in complimenting the declining outputs from agriculture. The research of Balama (2016) further emphasizes that a number of communities around the Iyondo forest reserve in Tanzania uses NTFPs both for subsistence and gaining livelihood capitals as a result of the relatively poor financial gains from their agriculture activities. Ahenkan and Boon (2008) examined NTFPs as a tool to addressing poverty concerns among poor communities through its contribution to livelihoods. With over 350 million people mostly in developing countries depending on NTFPs for income, food, nutrition and medicine (UNDP, 2004) there is clear indication that the study's finding offers an avenue for strengthening the sustainable conservation of NTFPs in the Lawra District for the maximum benefits. This study also determined that climate is a poor predictor of the availability of NTFPs in the Lawra District. This further strengthens arguments through the right measures and policies, communities in the Lawra District can adopt NTFPs as major revenue source and subsistence basis.

5.3 The Valuation of NTFPs and Its Contribution to Household Livelihood

The valuation of NTFPs has been discussed variedly in research on the approaches to conducting such valuations. According to Lescuyer (1996), valuation of NTFPs could be conducted through three approaches. The first he explained as getting the market values of the NTFPs of concern. This could be termed as a direct method of accessing financial information on the product of concern. If the direct method proves challenging, Lescuyer (1996) noted that in a second method, the market value of an NTFP is substituted for the nutritious value of non-marketed NTFPs. In his final method, he identified that in situations where both methods fail in providing valuation for NTFPs, the value of the NFTP can be estimated by assessing the time spent in the forest to

collect or gather the NTFP. In Adepoju and Salau (2007), they similarly distinguished between tradable NTFPs and non-tradable NTFPs. They noted however that the tradable NTFPs constitute significant recognition in international trade. Further, the whole process of valuation is seen not to be the inherent property of an entity. Valuation represents only "a measure of a relationship between a subject and the object of valuation within a context (time and place or hypothetical scenario)" (Adepoju and Salau, 2007).

This study measured the market value of tradable NTFPs as well as non-tradable NTFPs in the study area. Results indicated that non-traded NTFPs constituted the most used by community members as about 80% of the 78 identified NTFPs are not traded in the market. Despite this, they make up a significant aspect of supporting local livelihoods whiles acting as a safety net for residents in times of dwindling outputs from farming. Traded NTFPs however included the most common forms of NTFPs including Dawadawa, shea, baobab, kazuge and yellow berries that are still yet to make a sustainable significant financial breakthrough in the market. This supports the GSS (2010) report which indicates that Baobab, Dawadawa, shea trees and Acacia are all year round viable economic trees in the District due to their inherent resistance to drought and fire characteristics. The cash value realized through the sale of these NTFPs is noted to be woefully inadequate by traders even though they acknowledge its complementing role to household income (contributes only 1% to the total household income). This has been demonstrated in other parts of the world to be a viable avenue to supporting household income. In the Equateur province of DR Congo, a survey on traded NTFPs earned average monthly income of US$225 compared to represent the salary of two elementary school teachers' salaries of US$80-US$120 (Nkem et al., 2010). Similarly, Mukul et al (2015) in their study in Bangladesh estimated that

19% of household net annual income is from the sale of NTFPs in Satchari community. In Nigeria NTFPs provided income for various households through the sale of leaves, rattan, honey, sap and gums (Okafor et al. 1994). Charlie et al. (2004) noted that in South Africa about 85% of households used NTFPs such as spinaches, fuel wood, wooden utensils, edible fruits, bush meat, wild honey and reeds for weaving.

In addition to the financial returns of tradable NTFPs, both tradable and non-tradable NTFPs are also appreciated on their subsistence contribution to household livelihood. Varied uses have been assigned for non-tradable and tradable NTFPs including mainly its food and medicinal contributions. In British Columbia, Lipsey (1999) noted that the collection of NTFPs has offered employment to over 32000 people on either seasonal or full time basis. Apart from employing people, the types of NTFPs collected also offered cash returns to traders. Mukul et al. (2015) indicated that the collection of NTFPs was a major activity across all study communities in Bangladesh but also identified about 40 medicinal plants with regular uses to solve various forms of ailments. Wollengerg and Belcher (2001) noted that NTFPs have significant subsistence importance in rural economies despite the fact that only small number of them poses potentials of cash income and employment.

Adepoju and Salau (2007) summarized the role of NTFPs in its definition that states that

> *"NTFPs came from a large variety of plant parts and are formed into a diverse set of products: leaves and twigs that may be component of decorative arrangements, food items such as fruits, fungi and juices, wood carved or woven into pieces of art or*

utilitarian objects and root, leaves and a bark processed into herbal remedies or medicines".

The definition encapsulates food, arts (carved and woven) and medicinal benefits of NTFPs to households. Although the definition exempts animals as NTFPs they succinctly covered it under the classifying of NTFPs. The classes included broadly edibles and non-edibles with the former made up of plants and animals, honey, oils, fish, spices among others. The non-edibles also included grasses, ornamental plants, oil for cosmetic use, and medicinal products among others. In a vivid 4 category classification they looked at NTFPs as edibles, medicinal and dietary supplements, floral products and specialty wood products. These however do not differ from the findings of this study. The household roles played by NTFPs included all the classes defined by Adepoju and Salau (2007) except for floral products which included pine boughs, grapevines, ferns and plant products used for decorative applications. The study identified NTFPs that played significant roles in the provision of edibles which are usually consumed after harvesting fresh from the wild, including the baobab, yellow berries, suge among others. Again, medicinal and dietary supplements in the Lawra District were usually gotten from such plants as *gojezie*, *kakala*, *kakyelleh* and *Kyirn* including *Kyei* (animal intestine). Many others were also used as food supplements such as spices which included the baobab, shea and dawadawa among others.

Finally, specialty wood products included reports on the nascent carving and weaving industry. Such woody NTFPs are used in the carving of different home products as well as woven baskets among others. The role of NTFPs as discussed in Adepoju and Salau (2007) and the findings of this study are not exhaustive. The roles of NTFPs changes with ecosystem type and climatic zone (Rainforest and Savanna zones) and also the types of NTFPs available. Elsewhere, NTFPs are

noted to also be of cultural significance and value (Cooks et al., 2003). To that extent the list of NTFPs and discussions vary with reference to the study area. Even with same broad climatic ecological zones there could be area differences in the types of NTFPs and roles played. For example, bamboo constitutes a major NTFP in Ghana and about 7 species are found in Ghana (Anokye and Adu, 2014). The *Oxythenanthera abayssinica* specie type is the most common in northern Ghana, nonetheless it does not feature among the commonly identified NTFPs in the Lawra District.

5.4 The Management of NTFPs and Challenges Faced

NTFPs constitute a very important aspect of sustainable livelihoods for especially the poor and forest dependent communities. It offers an opportunity for rain fed agricultural dependent communities to diversify sources of income, supplement for subsistence food and nutrition and source of medicine for various ailments. According to Hamann and Wang (2006), some of the impacts climate change has on forest ecosystems are inevitable and therefore there is the need to ensure carefully planned adaptation and management strategies to reduce such impacts (Spittlehouse and Stewart, 2003). To such extent, NTFPs constitute a very significant resource used as a safety net in most parts of the world to support poor and climate dependent communities. CARE International (2004) revealed that forests in Burkina Faso and Ghana contributes about 3% and 6% respectively to the national economy through the provision of both wood and non-wood products (NTFPs) as well as regulatory, recreational and cultural services (FAO, 2014).

The study reveals that management of NTFPs is vested in the hands of local authorities rather than in the care of the state. Nygren (2005) also holds the view that in most developing countries the management of forest has been decentralized from the central to local government authorities. The decentralized idea he believes makes local people enjoy a sense of ownership in the rules that are made to manage the resources through such activities like implementation, monitoring and enforcement. The successful implementation of management policies is therefore dependent on the effectiveness of communities. According to Anokye and Adu (2013) NTFPs continue to be categorized in Ghana as minor forest products and so have received very little policy attention. He argued that the lack of definite policy on NTFPs has impacted the supply chain of management. Such development has led to slower promotion and development of the NTFP industry. Other researchers including Rijisoort (2000) noted that native knowledge on the management of NTFPs is essential in the broader forest management approaches. Marginalizing local beneficiaries in the management of NTFP resources could be detrimental as observed in the United States by Vaughan et al (2013) who noted the management of NTFPs should be a collective responsibility between governments and communities.

In the management of NTFPs in the Lawra District, both formal and informal institutions are involved. As observed by Nygren (2005), carefully blending the formal and informal institutions will help overcome multiple and conflicting interest for a successful community forest management. In the Lawra District, the study revealed that laws from the strategies adopted in the management of NTFPs included adherence to government policies, use of District Assembly by-laws, use of community by laws, reliance on community volunteer groups and moral sanctions. This shows a functionary blend of government and community regulatory systems working in harmony to overcome challenges in managing NTFPs and forests. The chi square

tests further reveal that each of the strategies adopted have a significant relationship with the communities. This implies that the efficiency of each of the strategies is community dependent. But clearly, all study communities have showed that the strategies were positively affecting the conservation of their forests. There were no clear incidences of power wielding in the control of natural resources in the study communities as the unique case presented included the formal institutions made up of the District Assembly and registered NGOS and GOs and the informal institutions made up of mainly the communities and their various authorities (Chiefs, Tindana, traditional healers, clan/family heads and youth groups). The wielding of power by sections in the control and access to natural resources as opined by Klooster (2000) and Gezon and Watts (2003) were not evident in this study. Therefore social stratification within the resources had very minimal effect in the governance of resources. This was particularly so because the acceptance of regulations on managing local forest resources was done in a collective manner led usually by the community leaders and the NGOs. Communities determine applicable sanctions and demarcate open forests and protected or parklands of NTFPs which are regulated. Such local by-laws are then sent to the District Assembly for acceptance before implementation. This allowed for an easy way of implementing such by-laws which become a collective binding instrument of conservation.

The management of NTFPs in the Lawra District at the individual level further decentralizes and increases people's sense of awareness and ownership of resources that strengthens the implementation strategies. The roles defined by individuals in ensuring the conservation of forest resources includes pouring libation to pacify gods when a sacrilege is committed, protection of sacred grooves, soothsaying to unearth impending disaster, assist chief and elders in resolving

natural resource conflicts and to facilitate the formulation and enforcement of community by-laws on natural resource. This shows increased participation of individuals in the decision making processes of natural resource conservation in the Lawra District which has led to fair access and to forest resources and social and economic benefits for all parties (Agyeman, 1994). Rijsoort (2000) opined that instituting local and indigenous knowledge and management techniques derived through participatory approaches, identifies also the cultural, social, ecological and spiritual significance of forests linked with the use of NTFPs have implications for the sustainability of the resources.

The assessment of challenges and threats to the management and availability of NTFPs in the Lawra District show that the absence of specific by-laws, harvesting and processing, climate change and animal and plant invasion threating the survival of some NTFPs were the pressing challenges. Since the emergence of NTFPs as a potential tool for sustaining forest dependent community livelihoods (UNDP, 2004; Ahenkan and Boon, 2008), policies and regulatory frameworks towards its development especially in developing countries have received very little attention (Ahenkan and Boon, 2008). This has been partly blamed on the over concentration on timber resource production as a more valuable commercial resource to the neglect of NTFPs by policy makers (Perez and Byron, 1999). The lack of regulatory policies on NTFPs is noted as the prime factor affecting the promotion and marketing of the resource and its development, a situation affecting NTFPs development in Ghana (Ahenkan and Boon, 2010). According to the authors several strategies instituted by the Ghana government in the alleviation of poverty and improving livelihoods has failed to consider NTFPs. They cited the Ghana Poverty Reduction Strategy Paper (GPRSP) and the FWP-1994 which stresses on public participation in District

level forest management for all forest products but failed to recognize the significance of NTFPs. In sum, Ahenkan and Boon (2008) noted that forestry policies are needed as a sure way in the promotion and development of NTFPs to reduce pressure on forest resources. Also the unsustainable means of harvesting forest resources affects the availability of NTFPs in the Lawra District. This is in line with Acheampong and Marfo (2011) who identified deforestation as a major threat to NTFPs that provides livelihood to over 2.5 million forest fringed communities. The rate of deforestation in Ghana has reached alarming rates of 65,000 hectors which if not checked could lead to depletion of Ghana's forest cover in the next 25 years (International Tropical Timber Organization, ITTO, 2005). Also, marketing of NTFPs have received very little attention and constitute a major challenge to the development of the nascent industry. In Tanzania, over 20 million people are noted to depend on NTFPs where climate change continues to threaten their livelihood security (CCIAM, 2012). Among the preliminary recommendations by the team to ensure sustainability and the development of NTFPs, the program noted that the challenges confronting the industry in Tanzania could be summarized under domestication, marketing and processing of NTFPs.

According to Upadhyay (2008), the major challenges confronting the management of NTFPs in Nepal included the lack of sustainable production practices, inappropriate harvesting and post-harvest practices, inappropriate value addition and poorly marketing information systems has hindered the promotion and development of the industry nationally and internationally. His study suggested a five step strategy to sustainably harvesting NTFPs which incorporates and emphasizes all forms of inventory taking a key component. Chupezi et al (2009) also highlights key ways in overcoming the challenges of processing and marketing of NWFPs (NTFPs) in

Africa. The study among many others noted that the addition of value locally, choosing the right marketing strategy, availability of legal information to producers, build capacity of local organizations and cost effective researches and disseminating appropriate information on NTFPs are the key ways of overcoming marketing and processing challenges in developing NTFPs as a safety net and resource for poverty alleviation.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary of key findings from the research results under the guidance of the specific objectives of the research. Also, the chapter provides a conclusion on the study as well as a number of recommendations targeted for policy interventions in the management of NTFPs as an adaptation strategy to rural livelihood.

6.2 Summary of Key Findings

The study findings are summarized in the following paragraphs:

Climate conditions continue to vary in the Lawra District. Temperature conditions for the last three decade have steadily increased reaching its highest in 2014 at 30.1^0C and lowest in at 25^0C over the last 30 years (1984-2014). Also, rainfall levels fluctuated over the 30 years period reaching its peak at 88.82 inches in 2009 and lowest in 2014 at 78.08 inches. Rainfall amounts have shown a decreased trend in the Lawra District since 2008. According to the respondents of the study, the changing climatic pattern has affected agriculture (farming) which is largely rain-fed in the District.

The major effects of climate change on residents included mainly reduced harvests (outputs) from farming activities. Other effects included the migration of members of households as well as health effects on individuals. The abysmal returns from farming have led many to adopt new strategies to support their livelihood. Among the list of adaptive strategies adopted by farmers included NTFPs collection, irrigation, reducing negative environmental practices, use of

fertilizers and improved seedlings, storage and trading/business.

NTFPs were available across all study communities despite the changing climatic patterns. A correlation test revealed a strong positive correlation at a significance level of P-value at 0.010 showing a strong correlation between communities and the availability of NTFPs. Similarly, a regression set up also shows that both temperature and rainfall were poor predictors of the availability of NTFPs. This makes a strong case for NTFPs as a climate change adaptation strategy for rural livelihoods.

A total of 78 NTFPs were identified in the study communities. These were made up both plant and animal NTFPs with many types found in all the communities. The most important and commonly harvested NTFPs included the baobab, shea, dawadawa, yellow berries and kazuge.
The distribution of NTFPs across the study communities were generally spread across all communities located mostly in the wild and around residential homes. However, the most harvested types coincidently also formed parklands due to their overly abundance at locations. Among all five identified NTFPs only baobab parkland was found to be shared between Kanpouh and Berwong.

NTFPs contributed to the livelihood of households in the Lawra District. Generally, NTFPs are used as food, medicine and as spices. The parts consumed depended on the type of fruit. But generally, for plants, the nuts, fruits, bark, roots and leaves were used for various purposes. Animal NTFPs however were in most cases consumed as whole parts. Apart from the contributions noted earlier, the study also valued traded NTFPs. The study established that the

traded NTFPs in the Lawra District contributed only 1% to the total income of the household. Despite its low contribution to household income, the importance of the non-traded NTFPs far outweighs its income value. It is significant in its contribution to the food demands of homes, medicinal values, and employment, nutrition and energy sources. Beyond these, its cultural and aesthetic values are also recognized.

In the management of NTFPs in the Lawra District, the key actors included stakeholders in the formal and informal sectors. The formal institutions included the NGOs, GOs and the District Assembly. The informal institutions however constituted local authorities identified as Clan/Family heads (32.9%), chiefs (31%), traditional healer (21.9%), Tindana (12.3%) and youth group leaders (1.9%). A number of strategies were identified by the authorities in conserving and managing NTFPs and forests in the Lawra District. These included adherence to government policies on forest management, use of District Assembly by-laws, use of community by-laws, reliance on community volunteer groups and moral sanctions. All strategies were noted to be effective across all study communities with very little variations. Individuals were also noted to play significant roles in managing NTFPs including pouring libation to pacify gods when a sacrilege is committed, protection of sacred grooves, soothsaying to unearth impending disasters, assist chief and elders in resolving natural resource conflicts and facilitate the formulation and enforcement of community by-laws. The study reveals that participation in the roles of pouring of libation, protection of sacred grooves and soothsaying were dependent on the religious affiliation of residents. Again, the participation of individuals in the roles of assisting chiefs and elders in resolving natural resource conflicts and formulation and enforcement of community by-laws on natural resources were dependent on the sex of residents.

Finally, the study reveals that the nascent NTFP industry in the Lawra District faces numerous challenges/threats in its management. The major challenges/threats identified included absence of effective by-laws, harvesting and processing, climate change, animal and plant invasions and marketing challenges/threats.

6.3 Conclusion

The study sought to investigate the management and use of NTFPs as a climate change adaptation strategy for households in the Lawra District. With increasing awareness on the impacts of climate change on agriculture, various forest communities have resorted to identifying alternative sources to sustainable livelihood. With decreasing yields from farming in the Lawra District, the abundance of NTFPs offers an alternative source of livelihood for households. There are clear indications that there is increase use of NTFPs among households even though this is most cases is for sedentary lifestyles, the resource is noted widely in other jurisdictions to have potential of also becoming a major income source to families. Currently, very little is realized from NTFPs in the Lawra District. The nascent industry is not climate dependent and therefore offers a pathway for forest dependent communities to overcome poverty and other livelihood challenges. The realizations from NTFPs will increase the access of households to human, social, financial, natural and physical capitals that will increase their resilience to climate change variability. This however remains sustainable with the adoption and practice of a wide range of sustainable management practices. A successful implementation of management policies on NTFPs will enhance the resources conservation and availability. Also, to ensure maximum benefits from NTFPs conservation, the strategies should be coupled with a deliberate plan to create a value chain of management incorporating production methods, harvesting, processing

and marketing of the products. These are the sure ways of increasing the financial value of NTFPs to levels to support rural livelihoods sustainably.

6.4 Recommendations

In the light of the key findings of the study, the following recommendations have been made for targeted policy and community interventions.

1. The District Assembly should take key role in ensuring agricultural input support for farmers in the Lawra District to continue engaging in farming the major livelihood of the residents. The provision of timely weather related information, fertilizers, improved seedlings, climate change resistant crops and notification of changing planting seasons.
2. There should be stronger collaboration between the NGOs, GOs and the District Assembly in educating and sensitizing farmers on changing dynamics of climatic change in the District and the appropriate coping strategies.
3. Current strategies of conserving the forest resources should be sustained while new ways of improving the current strategies are incorporated. Community led strategies on by-laws on bush burning, deforestation; sanctions (fees) among others should be strengthened to ensure the abundant and sustained availability of NTFPs.
4. The District Assembly together with NGOs should embark on deeper researches to reveal the various potential uses of unknown NTFPs in consultation with various research bodies in the country and also increase promotion of known and unknown NTFPs in the local markets, school feeding programs, tourists among other avenues. This however should start with a strong institutional commitment to inventory taking on all NTFPs to build strong policies to drive the sectors growth.

5. To adopt NTFPs as a climate change adaptation strategy in the Lawra District, there should be participatory approaches among all stakeholders to seek government and private assistance base on good inventory to establish a management chain from production, harvesting, processing and marketing. This way the income value of NTFPs can be increased to the benefit of households especially in worse scenarios of climate change.
6. Towards achieving a national policy on the Management of NTFPs, there should be a country wide consultation to seek inputs from communities dependent highly on NTFPs. This must include specific strategies to reach both the forest zones and savanna zones of the country. Academic researches including this could be a starting point for gathering scientific data towards NTFPs management policy in Ghana.

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APPENDIX I: QUESTIONNAIRES

Management and Use of Non-Timber Forest Products (NTFPs) as Climate Change Adaptation Strategy in Lawra District, Ghana.

HOUSEHOLD QUESTIONNAIRES
COMMUNITY:

This study is being conducted by a Graduate Student of the University of Ghana Institute for Environment and Sanitation Studies. It is to solicit for relevant empirical data for the completion of an academic exercise on how NTFPs are managed and used by communities and individuals as climate change adaptation strategy. Your participation is very much needed, and all your responses will be treated with complete confidentiality.

1.0.**GENERAL INFORMATION/ SOCIO-DEMOGRAPHIC CHARACTERISTICS**

1.1.Name of respondent (optional)……..……..

1.2. Sex (gender) 01) Male 02) Female

1.3. Age:……. Years.

01) 20-25 **02)** 26-30 **03)** 31-40 **04)** 41-50 **05)** 51-60 **06)** 60+

1.4. Marital status?

01) Single 02) Married 03) Window 04) Cohabiting 05) Separated/divorced

1.5. Education level: 01) None 02) Pre-school 03) Primary 04) JSS 05) Middle 06) SSS/Voc/Tech 07) Tertiary

1.6. Religion: 01) Christianity 02) Islam 03) Traditional 04) Others (specify)……

1.7.How many people live in this household?.....

Male >18years	Male <18years	Female >18years	Female <18years	Total

1.8.How long have you live in this community?.....years

01) <5 years 02) 5-10years 03) 11-20years 04) 20-30years 05) >30years

1.9.If you moved in, where have you moved from?.....

1.10. What position do you occupy in this community? 01) Tindana 02) Magazia 03) Clan head 04) Chief 05) Rain maker 06) Diviner 07) Member 08) Others (specify)……..

1.11. Occupation: 01) Farmer 02) Fisherman 03) Businessman 04) Employed 05) Unemployed

1.12. What are the major sources of income for your household?

Income Source	**Gross Income per year (GH₵)**

1.13. What are the main sources of food in the household? 01) Own produce from agriculture 02) Purchase from market 03) Gathering from the wild 04) Others (specify)……..

1.14. Indicate the kinds of livelihood resources that you have access to? (Select ALL that apply)

1. Land	2. Potable water	3. NTFPs	4. Cash/Credit
5. Technology	6. Farming inputs	7. Transportation	8. Market
9. Association	10. Social relations	11. Education	12. Healthcare

2.0.**RESPONDENT'S PERCEPTION ON CLIMATE CHANGE**

2.1 Are you aware of "climate change"? 1. Yes 2. No

2.2 From which source(s) do you hear about climate change? (Select **all** that apply)

	Media	**Name**
01	Radio	Station:
02	Television	
03	Newspapers	
04	Internet	
05	School	
06	Government agency	
07	Others (specify)	

2.3 What changes have you observed in rainfall for the past 15 years? (Select **ALL** that apply)

01) Shorter duration of rainfall 02) Heavy rainfall 03) Heavy storms 04) Late rainy season

05) Unreliable traditional signs of the start of the rainy season

06) Declining rainfall amount 07) others (specify)…….

2.4 What is the temperature condition in this area in the last 10-15years?**.....**

……..

2.5 What do you think is/are the cause(s) of climate change? (Select **all** that apply)

1. Natural phenomenon	2. Bad agricultural practices	3. Bush burning	4. Cutting down of trees
5. God's reaction to human sin	6. Burning of firewood	7. I don't know	8. Others (specify…..)

2.6. How does the perceived climate change affect your household livelihood?

……

2.7**.** How do you respond/react to the effects indicated in **Qn2.6**?

3.0.**IDENTIFICATION AND RANKING/PRIORITIZATION OF NTFPs**

3.1 What can you say about Non-Timber Forest Products (NTFPs)

.....

3.2 Do your household harvest/use NTFPs? 1. Yes 2. No

3.3. If YES, what type of NTFPs do your household collect/use? (Select **all** that apply)

NTFPs	**Types**	**Collected where**
Shea nut		
Dawadawa		
baobab		
Acacia		
Honey		

Bush meat	….	
Fire wood	….	
Thatch		
Fibres		
Vegetable	….	
Others, local/scientific name (specify)		

3.4 If NO, why?

3.5 What are the five (5) most important NTFPs in your household?

	NTFPs	**Part used**	**Use**	**By whom**
1		…….	…….	
2		……..	……	
3		…….	…….	
4		……	……	
5		…….	…….	

3.6 How long have you been using NTFPs? 1) From infancy 2) More than 30 years 3) 10-30years 4) Less than 10 years

3.7. Why do you go for collection of NTFPs?

3.8. What is the current state of usage and availability of NTFPs compared to the past 10 years?

Use of NTFPs	Period (months)	Reason for change	NTFPs Availability
01) Increasing		**NOTE: Go to qn.3.9**	01) Increasing
02) Decreasing			02) Decreasing
03) Indifferent			03) Same/unchanged

3.9. If NTFPs usage is increasing, what accounted for this? (Select **ALL** that apply)

1) Demand for NTFPs **2)** Proximity to NTFPs **3)** Reduction in crop yield **4)** Household demographic **5)** Reduction in household income **6)** Others (specify)……

3.10. On average, how many month(s) do you engage in NTFP works in a year?

1. 1-4months	2. 5-9months	3. 10-12months

4.0.**ESTIMATION OF FINANCIAL INCOME DERIVED FROM NTFPs**

4.1 What is the average annual income of your household? GH₵……

4.2 Is the income earned enough for the household for the whole season? 01) Enough 02) Moderately enough 3) Not enough 04) Can't Save

4.3. Do NTFPs contribute to your household income? 1. Yes 2. No

4.4. If yes, how much money did you earned from selling NTFPs for the past 12 month? GH¢…….

1	2	3	4	5	6
Less than 100	100-199	200-299	300-499	500-999	1,000+

4.5. Out of the money earned from NTFPs, how much was used to buy food items for the past 12 months? GH¢……

4.6. What were the uses of the rest of the money? ……..

……...

4.7. Are you willing to pay for the management of the NTFPs in this area? 1. Yes 2. No

4.8. If YES, how much money are you willing to pay for their management?

Traded NTFPs	Non-traded NTFPs
GH¢	GH¢

4.9. Are there available markets for NTFPs in the community or nearby towns? 1. Yes 2. No

4.10. Which market centers do you sell the NTFPs?

……

4.11. Who are the main buyers of NTFPs in the community? 01) Villagers 02) Middlemen from town/cities 03) others (specify)……..

4.12. What other benefits do your household derived from NTFPs? (Select **All** that apply) 01) Food 02) Employment 03) Nutrition 04) Medicine 05) Energy 06) Aesthetic 07) Others (specify)…….

5.0 **NTFPs MANAGEMENT/CONSERVATION STRATEGIES**

5.1. Which are the local/traditional institutions in the community that manage NTFPs?

01. chiefs	02. Traditional healers	03. Clans/family heads
04. Tindanas	05. Rainmakers	06. Youth groups
07. Others (specify)		

5.2. Which of the following are ways NTFPs are currently managed in the community?

Grade as follows: 1=very effective 2=effective 3=moderately effective 4=Ineffective 5=Not applicable

	Very effective	Effective	Moderately effective	Ineffective	Not Applicable
Adherence to government policies					
Use of District Assembly by-laws					
Use of Community by-laws					
Rely on community volunteer groups					
Moral sanctions					

5.3 What role do you play currently in the management of NTFPs? *Grade accordingly; 1= Very active 2= Active 3= Dormant 4=Not applicable*

	Very active	Active	Dormant	Not applicable
Pouring libation to pacify gods when a sacrilege is committed				
Protection of sacred grooves				
Soothsaying to unearth impending disaster				
Assist chief & elders in resolving natural resource conflicts				
Facilitate the formulation and enforcement of community by-laws on natural resource				
Ensure the enforcement of traditional norms, believes and practices on natural resource management				

Punish offenders of natural resource related by-laws				
Reporting offenders to authorities for punishment Others (specify)				

5.4 How were resources obtained for management of the NTFPs?

1	2	3	4	5
Fine from offenders	Funds from GOs/ NGOs	Community contribution	Proceeds from sale of community resources	Others:

5.5 Has management of NTFPs changed in the last 20 years?

5.6 If Yes, how?

.....

5.7. What are the challenges in the management/development of NTFPs in this community?

.....

5.8 What do you think should be done to manage NTFP better in the community?

.....

5.9. Which other institutions manage NTFPs in the community and the type? 01) Forestry Services Division 02) MOFA 03) EPA 04) District Assembly 05) NGOs 06) Others (specify)…….

THANK YOU

Management and Use of Non-Timber Forest Products (NTFPs) as Climate Change Adaptation Strategy in Lawra District, Ghana.

KEY INFORMANT INTERVIEW GUIDE

This study is being conducted by a Graduate Student of the University of Ghana Institute for Environment and Sanitation Studies. It is to solicit for relevant empirical data for the completion of an academic exercise on how NTFPs are managed and used by communities and individuals as climate change adaptation strategy. Your participation is very much needed, and all your responses will be treated with complete confidentiality.

Date……/……../2017	
Location	
Name of respondent (Optional)	
Organization/Institution/Agency	
Designation of respondent	

1. Which aspect(s) of natural resource(s) do your organization manages/support in its management?
2. What type of Non-Timber Forest Products (NTFPs) are available in this District? Please provide as many as you can. (Local name or scientific name).
3. What is/are your organizational policy/programme(s) and roles for the management of the resources mentioned in Q1?
4. Are the communities and their traditional institutions part of the management process?
5. If yes, how are they part of the management process?
6. If no, kindly give reasons.
7. How do you enforce the NTFPs' management practices?

8. What happens to person(s) for non-compliance?
9. What are the challenges in the management/development of NTFPs in this District?
10. What is your suggestion for dealing with the NTFP management challenges in the District?
11. Does your organization/institution has any policy/programme/project that support climate change adaptation process in the District?
12. If YES, can you describe what the policy/programme/project involves and its achievement so far?

APPENDIX II: NTFPs AT COMMUNITY LEVEL

S/N	ORIBILI	KANPOUH	BREWONG	TOLIBRI
1	Taame/ta'anga	Taame	Taame	Taame
2	Dooro	Dooro	Dooro	Dooro
3	Tokpara	Suge/ Suga	Tokpara	Tokura
4	Ore	Ore	Ore	Ore
5	Suge/ Suga	Gaa	Suge/ Suga	Suge/ Suga
6	Gaa	Kazuge	Gaa	Gaa
7	Gbeme	Tokpara	Gbeme	Tokpara
8	Kazuge	Ang-a	Kazuge	Aara
9	Lieme	Bang-na	Lieme	Lieme
10	Sansan	Gogoh	Sansan	Sansan
11	Goue	Gozang	Goue	Zangala/ob-nyukuo
12	Kolemakou	Gopula	Kolemakou	Kolemakou/poukalevaar
13	Baarigbe	Golezie	Baarigbe	Tou tee
14	Dunkum	Kakala	Dunkum	Dunkum
15	Swaka	Kakyelleh	Sur	Sur
16	Bere	Kalgbog-la	Gbaara	Kyera
17	Gyamgboro	Kakang	Tuvaa	Kyee
18	Torvaar	Kakankyikya	Bere	Dakune
19	Gbongkira	Kyira	Gyangboro	Naapuro
20	Saalung lellaa	Nmaaasugeh	Ob-nyukuo	Youvaa
21	Veega	Nminmiirakoler	Koko	Derbaa

22	Sur	Popong	Saalupela	Ong
23	Song	Saal-tie	Vega	Kure
24	Kure	Seetug-le	Kpagra	Wuola
25		Susug-le	Baa-ore	Mgmene
26		Togbo	Zupon	Zupon
27		Kpagra	Firewood	Malere
28		Song	Ben-ora	Mgbeme
29		Sansire	Onsagra	Sasere
30		Korenye	Grasses	Kalezur
31		Derbaa	Song	Song
32		Kyei		uoo
33		Mhaare		Segboro
34		Pure		

APPENDIX III: NTFPs IN NORTHEN SAVANNA ZONE

WOODY TREE SPECIES OF NORTHI WOODY TREE SPECIES OF NORTHERN SA WOODY TREE SPECIES OF NORTHERN SAVANNA - GHANA

SPECIE CODE	BOTANICAL NAMES	SPECIE	BOTANICAL NAMES		SPECIE	BOTANICAL NAMES		
		DAGBANI	GONJA	DAGARE	WALA	KUSAL	GRUNE	KASEM
1	Acacia dudgeoni	Goozie	Ewipepre	Gozie	Gopiela	Gozia	Gonmoliga	Sabarisinga
2	Acacia gourmaensis	Warifaa	Ewi	Gosabla	Gosagla	Kalampa	Gonyilanga	Sabarizunga
3	Acacia hockii			Golizie	Gozie			
4	Acacia macrostachya	Garinyini						
5	Acacia nilotica	Gbanzabgoo		Googo		Gbanzabgua	Zinzeriga	Sa'ngera
6	Acacia polycanta	Goopielga	Golgu	Goora			Goa	Pao
7	Acacia seyal	Goopienyan					Gopelidaa	Tonviu
8	Acacia sieberiana	Gopuhigu	Ewifufuo	Guor		Gonpelom	Go'npeliga	Sabaripungo
9	Adansonia digitata	Tua	Kalari	Tuo	Tuo	Teg	Tu'a'	Tiu
10	Afzelia africana	Kpaliga	Kawe	Kakala	Kpakpala	Kwakpalik	Kpaliga	Kolo'
11	Anogeissus leiocarpus	Shiiya	Kekale	Siktre	Siraa	Seeik	Shia	Lua
12	Anonna senegalensis	Bulumbugu	Prumpuse	Ba'tan	Baltan	Bawudu	Baoriga	Kawolo
13	Balanites aegyptiaca	Gabliga	Bete	Sansantie	Gongodaw	Kpalik	Cheko	Gurusaa
14	Bauhimia rufescens	Tohatagingu					Konbangire	Tabayara'
15	Blighia sapida		Kikye	Kyiraa	Kyihaa			
16	Blighia spp	Gwankpihiga	Kayelde	Gwamchiraa	Gwamchihaa	Pekovong		
17	Bombax buonopozanse	Vabgdaa'	Kawul				Vondaa	
18	Bombax costatum	Vabga'	Kpalimalugu	Vagatie	Vagadaw	Vuong	Vonga	Kaforo
19	Borassus aethiopum	Kpukpalga		Konkon	Konkon	Kokpari	Konkonga	Kongkor
20	Boswellia dalzielii	Kpiingoju		Pumpum	Kpanpolo		Chenchabagdgo	Soro.
21	Burkea africana	Gbanzalinga	Kroboto	Saltie	Sigle		Sayanga	Tayanga
22	Calotropis procera	Walapugu				Gbanpuu		Polo'
23	Cassia sabriana	Kulkparyoo						
24	Celba pentandra	Gunga	Kakliya	Guon	Guongo	Gung	Gonga	Gungu
25	Combretum ghalensis	Yurinpeli					Ko'nko'nsabliga	Kamagali
26	Combretum glutinasum	Ygokparle'	Tantebulase	Ounyoo	Gbaganuo	Yeekwadik	io-kariga	
27	Combretum molle	Gbiriga	Gbirige	Foroboro		Gberik	Buriga	Vosanga
28	Combretum nigricans	Yurinzie	Kafolege	Vazie	Koongee	Sunwarik		Tawranasinga
29	Crateva adansoni						Kuligunga	Bogong
30	Crossopteryx febrifuga	Sanpenga		Bombowul	Dondoliyele		Werimadia	Larebadia
31	Curculigo pilosa							
32	Danlellia oliveri	Nyoo	Kanyan	Kankyele	Nyanyaw		Nyaa'	Kache'lo
33	Detarium microcarpum	Kpariga	kookobi	Kpagraa	Kpagraa	Kwarik	Kinkaliga'	Kanankolo

WOODY TREE SPECIES OF NORTHERN SAVANNA - GHANA

SPECIE CODE	BOTANICAL NAMES	LOCAL NAMES						
		DAGBANI	GONJA	DAGARI	WALA	KUSAL	GRUNI	KASEM
34	Dichrostachys glomerata	Zangurung	Ekyenimo-bikokpebe	Sunsule	Gbegre	Goreg	Gotiga	Choa
35	Diospyros mespiliformis	Gaa	Kakebe	Gaa	Gaa	Gaa	Gian	Kekane
36	Entada abyssinica	Chincheenga'					Wogbodataa	
37	Entada africana/Sudanica	Zugulikukui		Zanzarenya		Sinnik	We'ldua'	Kanyansono
38	Erythrophellum africanum	Bukpung						
39	Erytrina senegalensis	Tanyibga'		Bomlasaabre		Zang	Gentarnotiga	Zantimologa
40	Euphorbia balsamifera	Jiriyura						
41	Fagara santhosytiodes			Pruwie				
42	Faidherbia albida	Puhuwunne'		Gozan	Gyanguo	Kankan	Zaanga	Sinzano
43	Feretia apodanthera	Busipiriga					Kanchegi-tindaa	Senyabia
44	Ficus capensis	Kinkangsalgu		Kankanpla	Kankalara	Kansipilik		
45	Ficus gnaphalocarpa	Kinka'n		Kakanga			Kinkanga	Kapuro
46	Ficus lepiri	Kinkangsigu'					Kinkansinya	Kaprepongo
47	Ficus platyphylla	Galinzegu		Kankanwie			Kinkansabliga	Kaprekawogo
48	Gardenia aqualla	Dazutikpurili	Lankparayin	Dazuredaa	Dajuodaw	Danzun	Dazunka'	Kantongnia
49	Gardenia erubscens	Dazunnasaga	Lankpara	Dazure	Dajuo		Sunsub rega	Kantongu
50	Gardenia ternifolia	Dazulinimbogu					Sunsubgwio	Kantonbia
51	Grewia lacoides							
52	Grewia laslodiscus	Yuelgadaa'	Kopuibi	Volpla		Somblena	Baslgoliga	Yala
53	Grewia mollis	Yuelega	Furubi	Voltle	Bayuole	Wong	Yoliga	Yala
54	Haematostaphis barteri			Zimbrima	Zimbrima		Gibga	Kwili
55	Hannoa undulata	Kambanga						
56	Heeria insignis	Soobiye'	Kpanflege	Nutuo	Nutuodaw			
57	Isoberlinia doka	Kpalsogu		Beltle	Beldaw		Ka'lga'	Nanjara
58	Khaya senegalensis	Kuga	Kikye	Kog	Kogo	Koke	Kuka	Pinu'
59	Lannea acida	Sinsabga'	Kupueylbi	Suge	Sunsugle	Sislbik	Sinsabiga	Kachugu
60	Lannea barteri	Sinsabple'gu'		Sinsule	Singelenge		Kyicha'	Kachuguboro'
61	Lannea kerstingii			Pogdolsuge				
62	Lannea macrocarpa							
63	Lannea microptera	Sinsabgbe'tilga'	Kinislbre				Chenchebtuliga	Kyebura'
64	Mangifera indica	Mango	Mangodibi	Mango	Mango	Mango		
65	Maytenus senegalensis	Zagoli		Zienvaguo				

WOODY TREE SPECIES OF NORTHERN SAVANNA - GHANA

SPECIE CODE	BOTANICAL NAMES	LOCAL NAMES						
		DAGBANI	GONJA	DAGARI	WALA	KUSAL	GRUNI	KASEM
66	Mitragyna inermis	Shieju	Bontodibi	Yilaa		Yelik	Yeliga	Toro
67	Moringa oleifera	Arizandatia		Onyokuo	Onyokuo		Poatim	Paliri
68	Nauclea latifolia	Gulungung	Gbungbum	Kalimagbola	Guongee	Guun	Kaligongo	Naul
69	Parkia biglobosa	Doo'	Kachundibi	Duotie	Duodaw	Duwa	Du'a	Songu
70	Pericopsis laxiflora	Zankungu,Kpiliga		Salzie	Hulee	Nalanzeling	Kyetiga,Nepeliga	Chekura
71	Pilostigma recticulatum	Bajinga		Bagidaa		Bandaa	Bagindaa'	Kavayonobia
72	Pilostigma thonningi	Bangida	Gbata	Bangna	Hambangne	Bann	Bagine'	Pipono
73	Prosopis africana	Nanzili, Langinga	Brumpolia	Saldopure		Nazire	Nanzuiire'	Bosungu
74	Pseudocedrela kotschyi	Sigirilii	Kichie	Dol	Bongadaw	Segrik	Sisigete	Gyebori
75	Pterocarpus erinaceus	Nee'	Gyankelia	Liga	Boniaa	Nelik	Nia'	Tentenga
76	Sclerocarya birrea	Mumuga				Nanobik	Nanobiga	Kansolo
77	Securidaca longepedunculata	Paliga'		Pla	Pelaa	Kpelik	Pariga	Shia
78	Securinega virosa	Susujura		Nyaara		Perik	Kanchilenga	
79	Simenia americana		Pumfula					
80	Sterculia setigera	Pulunpung		Pompom	Pumpumge	Pumpum	Pumpunka	Kapolo
81	Stereospermum kunthianum	Zugubetia		Kontipla	Kondaw	Nayiriuyie	Dayiya'	Lentera
82	Sterospermus spp			Kontipla	Kondaw			
83	Strophantus hispidus	Yagba				Yeebik	Yagba	
84	Strychnos spinosa	Gingagigo'o'	Pumpumga	Pompuloro	Papalore	Ponsinpul	Che'liponga	Kampoa
85	Strychnos triclisioides					Ponpondaa	Kinlipondu	
86	Syzgium guineensi	Kuldirigu						
87	Tamarindus indica	Puhuga	Pompulima	Puretie	Puhidaw	Pusik	Pusiga	Sana
88	Terminalia avicennoides	Ko'rli'	Kipalari	Kotre	Vapiela	Portere	Petire	Kogo
89	Terminalia macroptera	Korlinyang	Lankpara				Konlinkaesi	Kokom
90	Unknown spp			Dantin				
91	Unknown spp			Langele				
92	Vitellaria paradoxa	Ta'anga'		Tantie	Tandaw	Tang	Ta'anga	Songo
93	Vitex diversifolia	Daringadaa'	Tiktikye				Aaringtuliga	Kayono
94	Vitex doniana	Daringa	Kakulugu	Aanna	Haara	Arig	Aariga	Kayontula'
95	Ximenia americana	Lienli	Kenyayenbi	Lientie	Sinkpiledaw	Lien	Leenga	Mia
96	Zanula africana		Kuposebi					
97	Ziziphus mauritania	Naatirichiriga		Gbong-borechile			Goe-etiye	Nadiru'